The New Public Health

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PREFACE

The Problem.—Until such time as poverty is abolished, or the State takes charge of children, the majority of the women of the race must continue to rear the majority of the children of the race inadequately, in homes too small, without facilities, doing for them somehow, individually and alone, that which three women could hardly do well, working together.

This is not wholly a slum problem nor is it a problem of the rich. Numerically the race is chiefly middle class, neither rich nor extremely poor, judged by ordinary standards. This is the problem of the family with an income below $3,000, i. e., it is the problem of the race proper, and it is the old problem of the pre-mosaic Hebrew—how to make bricks without straw—alas, often without knowing how to make bricks at all.

The problem as a whole involves food, clothing, proper physical development, morals, education, amusement, discipline, and citizenship. But the public hygienist has **as yet** but indirect concern with these. The public hygienist—the "board of health man"—**as yet** concerns himself chiefly and by general expectation and consent, with the grosser, more imminent, more spectacular, more immediately tragic problems of disease and death, and chiefly with only one group of these, the infectious diseases. However much in ordinary life over-crowding, lack of facilities and over-burdening of mothers may render unavailing even the tears and ageing, the back-ache, heart-ache, crooked fingers and wrinkled faces of mothers striving for their young, ten times over is the effect of these seen when disease enters the family, adding its burdens, its sorrows, its disabilities and its deaths.

Once more, remember this is not in the slums alone, nor, numerically, chiefly there. It is found in city and country, village and town, everywhere, the overburdening of mothers, in ordinary life, added to ten times over when disease springs up.

How Big A Problem Is It?—Call the population of the United States 80,000,000. Remember that sooner

or later, every member of each generation suffers from at least one infectious disease, often from two, three or four, and it is clear that every generation suffers anywhere from 80,000,000 to 240,000,000 attacks of infections. Each generation pays out at least eight billions of dollars for this running of the gauntlet, not to speak of the disability and death of those who run it successfully. Tuberculosis, diphtheria, summer diarrhea, scarlet fever, measles, typhoid fever, whooping cough, chickenpox, to name only some of those best known to the laity, how much sorrow, distress, poverty, how much "making of none avail" of mothers' hopes and prayers and wearing effort have these caused! Yet so common are they that "childrens' diseases" are looked upon as a necessary stage, almost a joke. Indeed some people deliberately expose their children to them, "to have it over with!" Yet who bears the burden, the sleepless nights, the extra work, the hope deferred?

Ninety-five per cent of the infectious diseases are nursed at home by mothers. Next to the children themselves the ones who suffer most are mothers.

Who Keeps the Infectious Disease Going?—Once more the answer is—and most emphatically—women in general but chiefly after all the mother. To be sure there is every excuse for the mother, —overwork, overcrowding, lack of facilities, above all ignorance and misdirected training, "misinformation piled on lack of any." But with all the perfectly good apologies stated and all the excellent good-will and effort counted in, the fact itself remains, that mothers propagate and keep alive and spread the infectious diseases of children more than any other one body of people, and that while conditions remain as they are they must learn the "rules of the game" and follow them, for no amount of coaching or effort from the sidelines can do more than help.

Why and How Are Women Responsible?—Because mothers are doing the work—women in general, but chiefly mothers. The farmer is responsible (apart from flood, drought, storm or other "acts of God") for whatever happens to the crop from seed to market. Women in general—but chiefly mothers—are the "raisers" and "crop-handlers" of the largest, most valuable, most expensive and most difficult crop in the country. What happens to this crop between birth and sixteen years of age is, chiefly, what women do to it, or at least do not prevent. For the first 5,000 days of the years of the life of each generation,

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Present Attempts.—To teach women, girls, prospective mothers, that they may practice in their households, and in turn teach their children to war on invisible germ-foes is one of the functions of public health bacteriology. Only in the public schools can it be taught with emphasis, weight and uniformity enough to impress the masses. Only if taught in the grades can it be counted upon to reach the masses. Less than 1 per cent of the population reach the university, only 10 per cent reach the high schools. The great mass of the mothers of the coming generation, of the whole race, the mothers of more than their average of children, are receiving grade school education only. Need more be said?

The infectious diseases in general radiate from and are kept going by women. Women must learn to break up, divert, stop in some manner—in every manner—the exchange of infected discharges amongst children at school and amidst families at home if infectious diseases are to be abolished or abated under present conditions. The needful information, beliefs, technique and habits cannot be had or established except by studying the basic principles of public health, and this must be taught in the grades of the public schools if it is to reach those who most need it.

Radical Changes in Social Conditions the Real Solution.—If (as cannot be) every girl now at grade school could be thoroughly taught all that a trained nurse knows, theory and practice, the best to be hoped is that, becoming a mother, ten to twenty years hence, she may remember enough to care for, if she have the facilities, the first case of infection in her household without permitting its spread to the other members or to outsiders. Alas, not one third of the girls will remember, not one-tenth will have the facilities. Above all what shall be done in that intervening ten to twenty years? Lectures, writings, sermons, appeals to mothers' clubs, university extensions, moving pictures, all the publicity that can be had or hoped for, will not suffice to teach technique to the mother now in possession of the coming generation. Nor once more, if it taught them, would it provide the facilities needed. Economic conditions must change and change specifically to aid the mother if we are to gain at all. Also, the prevention of disease must engage the serious attention of governments—the *prevention* of disease, not the talking about it or the looking wise over it, or the making of fine addresses on it, but *preventing* it. Such prevention may include a tremendous organization to prevent human discharges entering water supplies, milk supplies, food supplies; must involve watchfulness of hotels, restaurants, public institutions of all sorts—in short, of all public alimentary utilities, with all their off-shoots and side issues wherever found. It must include, as its chief and most efficient weapon, the finding of the sources of infection, and the prevention of spread of infection from those sources. This is peculiarly a governmental function, but the whole must be cooperative. The government must strike at the sources and at the public routes of infection. The woman must strike at the private routes. The man must support both methods for the sake of the women and children.

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Chapter I

THE OLD PRINCIPLES AND THE NEW

THE REVOLUTION

The statement that there is a "New Public Health" may shock those who, although familiar with recent changes in scientific thought, yet have not fully realized what those changes mean; but the shock will be far greater to those who have not appreciated that changes were going on.

The purpose of the writer is to formulate for both groups, the unconscious progressive and the unconscious conservative, a brief statement of the essential principles of modern official public-health work. To those who may feel skeptical as to the fairness of this exposition, the writings of Chapin, the great American pioneer of modern public health, of E. O. Jordan, and of M. N. Baker, may be offered as bearing directly upon these questions, while the whole of modern technical public-health literature may be offered as indirect evidence.

The old principles have merged gradually into the new, in keeping with the experiments, observations, and conclusions of many investigators in many individual sciences related to general public health. Within official public-health circles, bacteriology, clinical observation, and mathematics have furnished most of the reconstruction. The bacteriologist, the epidemiologist, and the vital statistician, sometimes working together,

more often alone, in the dark and even at cross purposes, have nevertheless all reached the same point, and today each finds his co-workers beside him. Much of the work done has consisted in clearing away the fallacies built up by tradition, but construction-work has gone on also, and it is now possible to formulate the results.

The essential change is this: The old public health was concerned with the environment; the new is concerned with the individual. The old sought the sources of infectious disease in the surroundings of man; the new finds them in man himself.

The old public health sought these sources in the air, in the water, in the earth, in the climate and topography of localities, in the temperature of soils at four and six feet deep, in the rise and fall of ground-waters; it failed because it sought them, very painstakingly and exhaustively, it is true, in every place and in every thing *where they were not.*

The new public health seeks these sources—and finds them—amongst those infective persons (or animals) whose excreta enter the bodies of other persons.

The old public health failed to find the sources of infection; it also failed in most instances to find the routes of transmission. It is true that public water-supplies were detected as at times transmitting infection; but milk was hardly suspected twenty years ago, and flies, suggested in 1887,[1] were not seriously considered until the Spanish-American war; mouth-spray[2] and

[1] Wm. H. Welch: Address at the Annual Meeting of the Medical and Chirurgical Faculty of Maryland 1887, quoted in "Sewage and Local Drainage."—Waring, 1889.

[2] By this is meant the fine droplets thrown out from the mouth in speaking, singing, laughing, sneezing, coughing, etc.

hands have been only recently recognized as important. On the other hand, dirty clothes, bad smells, damp cellars, leaky plumbing, dust, foul air, rank vegetation, swamps, stagnant pools, certain soils, smoke, garbage, manure, dead animals, in fact everything physically, sensorially, esthetically, or psychically objectionable, were lumped together as "unsanitary" without much distinction of "source" or "route," and were regarded as a sort of general "cause of disease" to be condemned wherever found, "for fear of epidemics."

THE OLD TEACHINGS

It was taught that infectious diseases "generated" in the foul, ill-smelling, unventilated, sunless hovels of the slums. In the vogue of those days, "the slum-dwellers live like pigs, and thereby invoke the coming of smallpox, scarlet fever, typhoid fever, diphtheria." When these diseases invaded the home of the well-to-do, where this explanation was not seemly, a pinhole leak in some plumbing fixture accounted amply for diphtheria; rotten potatoes, forgotten in a dark corner of the cellar, for typhoid fever; scarlet fever was traced to a letter from a friend who had had the disease months before; smallpox to unpacking books used by a patient a quarter of a century previously; manure piles gave rise to cholera; and dampness to malaria, which was not recognized as transmissible at all. Yellow fever originated in impure water and was directly transmitted from person to person—a typical example of intense direct contagion; tuberculosis was non-infectious and hereditary; bubonic plague was banished from the Egyptian Cairo "simply by improving the ventilation of the city" (!)[1]

[1] Parke's Hygiene, 1891; eighth edition. This was a standard work of twenty years ago.

Remedial and preventive measures, based on such beliefs in the omnipotence of environment, naturally sought to remodel the lives and immediate home surroundings of the whole population to conform with a vast array of alleged "sanitary laws of health." Yet he who seeks for a scientific demonstration of the relations existing between disobedience of these "sanitary laws" on the one hand, and the incidence of disease and death on the other, will find only a "twilight zone" in which move vague shadows of traditional fear, shadows which, on probing, fade mistily away.[1]

The New Public Health is not worried by elaborate theoretical possibilities, but concerns itself earnestly with practical probabilities. The occasional, unusual, bizarre routes of infection in the one per cent of cases, do not distract its attention from the usual, practically constant, simple, ordinary routes concerned in the ninety-nine per cent. Its main postulate is that the routes of infection are simply the routes of infected bodily discharges, which, again, are identical with the routes of ordinary uninfected discharges in ordinary life.

The old style "sanitary inspector" was expected to, and usually did, "condemn" everything in sight, from the garbage pail at the back door to the plumbing in the bath-room. But disease continued, because he was condemning, as a rule, so far as health was concerned, things largely "incompetent, irrevelant and immaterial." What availed it that the garbage-pail was emptied every day or a vent-pipe placed on the bath-water waste-trap, if the milkman delivered scarlet-fever-infected milk at the door, or an unrecog-

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[1]See Journal-Lancet of July 15, 1914.

nized case of measles sat next the children at school?

THE NEW IDEAS

The New Public Health sees in the garbage-pail merely a place where flies are fed and, possibly, bred. But the flies cannot carry infection *if infected discharges are not accessible to them.* "Defective plumbing," such a nightmare twenty years ago, has been conclusively shown to have nothing to do with disease-generation or disease-propagation whatever, unless perchance there be actual gross leakage of infected sewage. The unventilated front parlor could not produce tuberculosis in a hundred years; diphtheria does not develop from the family well; and typhoid fever in sand or clay soils is but seldom properly traceable to that source, either. The modern public health man cares nothing, so far as restriction of disease and death is concerned, for the dirty back yard or the damp cellar in themselves, but only as they may enter into the transmission of infected discharges. Then, at once, they become of vital importance. The sanitary inspection of the modern sanitarian, so far as relates to infection, begins and usually ends with the search for (a) the infected individual; (b) the routes of spread of infection from that individual; (c) the routes of spread of the ordinary excreta of ordinary uninfected individuals to the mouths of their ordinary associates in ordinary life. These latter are sought for, not because of danger from such uninfected discharges, but rather because infected discharges, introduced into and following the same well-beaten paths, will necessarily reach the same mouths. To locate all the infective persons and to guard all their discharges would be wholly sufficient, but since this cannot

always be done perfectly, it is well to guard also the routes which unlocated infection may take.

ENVIRONMENT

Has environment, then, nothing to do with infectious diseases? Environment acts in two ways: First, unequivocally and without reserve, such environments as permit or encourage or, still worse, necessitate the exchange of human excreta in ordinary life, contribute in the long run to the spread of disease since they insure a similar exchange of infected excreta so soon as the latter are introduced.[1] Let us take one environmental evil, overcrowding, as an example. Overcrowding, if combined with lack of discipline and order, and lack of facilities for washing, especially for the washing of hands, contributes to the spread of infectious diseases; but not in itself, nor at all, unless infection be introduced into the community. Then overcrowding, because it tends to insure exchange of human excreta, tends also to insure that the infection will spread rapidly and extensively. But overcrowding, if the overcrowded be disciplined, intelligent, and take proper precautions to avoid exchange of excreta, does not necessitate the spread of infection, even if it be introduced. On the other hand, infection may spread, and frequently does, without overcrowding, if the essential factor of such spread exist, i. e., the transmission of infected excreta.

Second. Environments that are bad from a physiological standpoint (bad for the body, regarded as a delicate biological machine) are often held to act in spreading infection indirectly by

[1] An excellent exposition of this effect of environment on the spread of disease is given by Chapin in the Report of the Providence Health Department for 1910.

"depressing vitality" to an extent which makes infection, if received, more likely to develop (and if it develop, more successful in injuring the body). It must be said, however, that the evidence on this point, except perhaps that relating to tuberculosis and pneumonia, is very slight. It is a debatable question whether or not overcrowding "depresses vitality" in the direction of increasing susceptibility to infectious diseases, whatever its effect may be in encouraging "general debility." It is a very debatable question whether or not "poor ventilation," to which the effects of overcrowding are often attributed, can or does "depress vitality" in the direction of lessening resistance to infectious diseases, whatever bad effects it may have on mental vigor or physical activity. It is true that there is evidence that such environments as lead to extremes (beyond the limits of compensatory adjustments by the body forces) of mal-nutrition, of temperature, of fatigue, and of alchoholism, probably may have an effect in insuring the development of infection, which under better conditions might be negatived by the body forces. Especially may these forms of bad physiological environment be influential when the dose of infection is small, infrequent, or low in virulence. But starvation, unsuitable temperature, fatigue, alchoholism, alone or together, cannot induce infection, nor will the converse conditions, alone or together, offset the effects of infection when the dose is large or frequently repeated or of high virulence.

Chapter II

INFECTIOUS DISEASES

FACTS

It would appear, then, that environments affecting bodily functions have little to do directly with the incidence of most of the specific infections,[1] notwithstanding that nutrition, temperature, fatigue, and alcoholism are generally credited with some effect, especially in pneumonia and tuberculosis.

Damp, cold, and fatigue perhaps precipitate the pneumonias, provided one of the infective agents be present. The environments that precipitate tuberculosis constitute a problem as yet unsolved. Very much is widely believed, and even more is freely taught, concerning this subject, but the evidence is tangled and often contradictory. "Poor ventilation," dust, dampness, etc., have all been accused, but very little has been proved concerning the real factors actually at work or their mode of operation. In the other infectious diseases the effects even of extremes of the above factors are but rarely definitely recognizable. One thing, and one thing only, is absolutely established, namely, that tuberculosis, microbic pneumonia, and the other infectious diseases will develop under almost any circumstances if the

[1]The terms *contagious* and *infectious* were formerly carefully used and carefully distinguished. Modern writers, however, fail to find any useful or basic significance in "contagious" as contrasted with "infectious." Hektoen, in Osler's "Modern Medicine," discards "contagious" and "contagion" entirely.

In these articles "infectious" is used to mean "transmissible" or "communicable."

monia, and the other infectious diseases will develop under almost any circumstances if the dose of infection be large enough, virulent enough, or sufficiently repeated. Tuberculosis, pneumonia, and the other infectious diseases will not develop under any circumstances without such infection.

Hence it must be evident that the *sine qua non* of all infectious diseases are their respective agents, and that, since the chief sources (infective persons) of these are known, the most logical efforts are those which concentrate on the prevention of the dissemination of these agents from these sources.

This is tenable, not only in theory, but in practice, and presents an infinitely simpler administrative problem than that presented by the older hypotheses,—not only in the minor infectious diseases, where these principles have been practically accepted by all, but even in tuberculosis itself.

Thus, if "general environment" be the great factor in tuberculosis, the two million people of Minnesota must have each his or her own individual environment brought up to and kept at some standard-level designed to maintain each individual in his or her own alleged "highest state of health."

If, however, the infectiveness of the disease be the great factor, only three thousand people (the actively infective cases) need this supervision, in Minnesota, and they need it, not for the improvement of their "general environment," but *merely to prevent them from infecting others.* This problem, even numerically, is but one seven-hundredth the magnitude of the other. Consider the utterly impracticable expense and difficulty of the State attempting to insure only the four quoted factors,—good food, proper temperatures, tem-

perance, and repose,—to two million people (to say nothing of the other "factors of safety" called for by those who lay chief emphasis on control of environment, i. e., abolition of foul air, smoke, dust, damp cellars, bad smells, dirty back yards, etc.), and contrast with this the expense of State supervision of three thousand people *merely to the extent of confining their infective discharges to themselves.*

Further consider that the same official mechanism which could control the three thousand tuberculous could also handle with but slight expansion the infectious persons needing supervision for the prevention of all the other infectious diseases, except the venereal, as well as the infective tuberculous. Remember also that improvement of the "general environment," allowing that its effective achievement were conceivable, could not be expected to have any noteworthy effect on most of these other infectious diseases, even though it had some on tuberculosis.

Need any more be said to indicate the superiority of the new principles as practical business propositions, over the old? The latter would require the realization of the millenium and an expenditure of untold millions; the former could be put into operation in three months, with an expenditure of twenty-five cents per head of the population.

The stumbling-block is that the general public still believes the teachings of twenty years ago concerning environment. These teachings were a mixture of the "old-wives fables" of the pre-bacterial age, with the early incongruities and half-truths of the new "theory" of bacteriology.

Bacteriology is now an old-established science; but despite the fact that it has changed public-

health work even more than it has changed medicine or surgery,—and both of these it has completely revolutionized,—the public still clings to the belief that public health is a curious profession, absorbedly interested in cutting weeds in vacant lots ("to prevent epidemics"), in burying dead animals and suppressing noisome odors ("to prevent epidemics"); in inspecting plumbing and collecting garbage ("to prevent epidemics"). The "good" health-officer is he who keeps the streets clean and the back alleys neat, and who falls into a rapture over a newly whitewashed outhouse and into a rampage if a pile of old bones is found under the cellar steps. Yet those who know better let these ideas alone, or even acquiesce in them, "to save trouble." Then it is expected that the carefully uneducated, or miseducated, public opinion will demand up-to-date laws! Is it any wonder that the public insists on thinking, acting, and legislating to suit the theories of twenty years ago instead of the scientific knowledge of today?

Creeds are often misleading, incomplete, or fallacious; yet the temptation to formulate the new principles briefly is strong, because their intelligent presentation to the public is so vital. Such formulation is attempted here.

a. *Sources of Infectious Diseases*

1. Infectious diseases are infectious because they are due to the growth, in the body, of minute animal or vegetable forms (germs), the transmissibility of these germs from body to body being the sole explanation why these diseases are "catching."

2. Wherever in the body the germs develop, they leave it chiefly in the discharges, or by

routes of the discharges, of the nose and throat, bladder, or bowel, i. e., from the main orifices of the body.*

3. The discharges infect another person practically only when that person takes the discharges, in some form, into the mouth or nose, except in trachoma and the venereal diseases.**

4. Outside the body, disease germs do not multiply in nature, except perhaps rarely, and very temporarily in milk, water, or similar fluids. In general, even typhoid bacilli disappear from water supplies within two weeks, without evident multiplication. If introduced into milk, most infectious-disease germs die out as the milk becomes acid, generally in a day or two. Infectious-disease germs are rarely found in garbage, and they quickly die out if deliberately added. Practical modern public health recognizes therefore that the bulk of most of the infectious diseases are derived directly, or almost directly, from infected persons, not much from infected things, except water, milk, food, and flies. The danger from the general environment of an infected person is therefore small. The *things* in his neighborhood need little consideration, except those very immediately about him and directly infected by his discharges, such as bedclothes, personal clothes, towels, eating utensils, and other material objects that may receive, and retain for a time, fresh moist discharges. If attention be efficiently directed to in-

*This applies to all the ordinary infectious diseases in this state. Smallpox, leprosy, syphilis, and some forms of tuberculosis are transferable from skin lesions at times. Certain tropical diseases are transmitted by insects tapping the blood-stream, etc. Probably all infections can be conveyed, as anthrax and tetanus usually are, directly by inoculation. But these paths are so rare as to be negligible in ordinary life here.

**"Infection is transmitted from an orifice of the infector to an orifice of the infectee."

fected persons and their discharges, the general surroundings may be safely ignored, except in the rarest instances.

b. *Routes of Infectious Diseases*

5. The routes by which the discharges of the sick person pass to the well person are exactly those by which the same discharges pass from the well person to the well person in ordinary life; for nose and mouth discharges the routes are sputum and mouth-spray, conveyed through direct contact (as in kissing, etc.), and by the hands; for bowel and bladder discharges, the hands chiefly; and for all discharges, the things infected by them directly or through the hands, especially those things which then go to the mouth or touch things which go to the mouth, as food, water, eating utensils, towels, pipes, etc., etc. Flies also furnish an effective route, especially to food. Water supplies are peculiar, because bowel and bladder discharges *en masse*, in the form of sewage, often enter them directly, at times being deliberately poured into them from city sewers.

6. The relative importance of these various routes in the carriage of infection varies much. The amount and freshness of the discharges, the number and virulence of the germs they contain, the size and frequency of the dose, and the number of susceptible persons who are dosed, must always be considered. Almost all the ordinary infectious disease germs die out quickly on exposure to direct sunlight, and fairly rapidly in diffuse sunlight. When mucus, feces, and urine are thoroughly dried on furniture, door-knobs, etc., they are not readily removed again without moisture and friction, and when so removed the

disease germs in them are likely to be dead or greatly reduced in recuperative power because of the drying. Hence, as a rule, *things* succeed in conveying infection only somewhat directly from the infector to the infectee, and practically only during the limited period when the germs are still fresh and moist.

c. *Control of Infectious Diseases*

7. These new principles place at the head of official public health activities, the search for and supervision of infected persons, and the control of the infected discharges, for the purpose of excluding them from mouths, and therefore also from food and drink. Prompt intelligent disinfection of all the excreta immediately after their discharge from the body, is the best weapon in the supervision of infected persons. Isolation of the infected person is the next best, and is more universally practicable, because immediate intelligent disinfection of discharges can rarely be secured outside of the very best hospitals for contagious disease. The search for and supervision of mild, early, convalescing, unrecognized, and concealed cases and carriers, as well as of frank cases, is necessarily an essential item in the scheme.

8. The modern public-health department requires experts, but not experts in municipal housekeeping, in street-cleaning, garbage-disposal, smoke-prevention, etc. Its experts are the vital statistician, the epidemiologist, the laboratory man, and the sanitary engineer, the latter dealing chiefly with the broad questions of water-supply and sewage-disposal.

Chapter III

NON-INFECTIOUS DISEASES

SPECULATIONS

The previous chapters indicated that so far as the infectious diseases are concerned, the great public-health fallacy of the 19th century consisted in the devotion of nearly all the effort to man's surroundings; of almost none at all to man himself. We know now that the sources of infection are in man; that the routes of infection are the routes of man's discharges; and that the discharges are harmless until they enter man again. It is true that when the infective agents reach their goal the resistance of the individual, pitted against the injurious powers of the infective agents, decides whether or not actual disease develops. But this resistance of the individual is not to be measured by his surroundings: it is intrinsic in himself. Alterations of intrinsic resistance do, of course, constantly occur, but the factors of those alterations are not, as a rule, to be readily ascertained. We think that great extremes of malnutrition, temperature, and so forth may "depress" resistance. We have evidence that the smoke nuisance, poor ventilation, or smells from slaughter-houses do not. In brief, granted sufficient exposure to infectious disease, the susceptible individual will succumb, though he live in a palace; the immune individual will escape, though he dwell in the slums.*

*Tuberculosis has long been held an exception to this rule. But tuberculosis was also long held as (a) non-infectious and (b) hereditary, as well as (c) a result of certain surroundings. We have reversed (a); we have reversed (b); we may yet see good reasons to modify (c).

The outcome of the 19th century environmental doctrines was the binding of heavy burdens of routine administration concerning surroundings upon health departments. Results: garbage disposal, a polytechnic trade; street-cleaning, a scientific profession; plumbing, a fine art; and the supervision of infection, a dubious and usually a temporary "job."

We have pursued chimeras; pursued them in good faith of course, but chimeras none the less.

Suppose now that we admit our errors and give to the supervision of tuberculosis,** which we do understand, one-half the effort we have given to the supervision of ventilation, which we do not understand. Suppose, in brief, we really organize and really operate a real machine which really does reduce, even promises to abolish, the infectious diseases. Will it be a surrender of our birthrights for a mess of pottage if we forego the chasing down of loose paper on the streets and the cleaning up of rubbish piles on vacant lots, to turn our attention solely to the "mere abolition of infection"? Are there not activities contributing to health beyond these limits? Surely, yes; and some of them are things that should be done at once without waiting for that "mere abolition" to be accomplished. For example, everyone knows that the bodily welfare of mankind does not by any means hinge wholly on the infectious diseases. True, the abolition of these diseases means also the abolition of their immediate sequelæ,—sometimes as in measles, more harmful than the original attack,—and of their remote sequelæ, the permanently injured kidney and the permanently weakened lung. But even so, a full half of our

**To say nothing of syphilis, gonorrhea, summer diarrhea, and the rest.

medical diseases and much more than half of our surgical diseases would still remain; moreover, merely to remove disease is not to solve the whole problem of securing health in its true sense, i. e., the highest physical efficiency prolonged for the greatest period of time.

THE GENERAL PROBLEM

The chief of the many phases of disease and health are best shown by a parable:

As a new automobile is accompanied by detailed instructions for its care and operation, so the new small citizen should be accompanied by detailed instructions for *his* care and operation when he, a delicate and complicated machine, indeed, first appears on the scene. This knowledge is now accumulated by his parents chiefly from experience (which, remember, are *his* experiences) or by picking it up at random from the neighbors over the back-yard fence.

Again: As a new automobile is searched solicitously for missing or defective parts, to be solicitously and immediately made good before the machine is sent out to run against competitors on the highway, so the new small citizen should have at least his sight, his hearing, and his breathing tested before he begins the inevitable compulsory-education race against all comers on the public highway of the public schools. But further: As the most initially perfect automobile, most skillfully run, will yet, as time goes on, meet accidents, develop internal disruptions, and require repairs, so the new small citizen, despite early care and early correction of defects, will need supervision and repair all through his life, at school and afterwards.

The parable must end here, for automobiles

present no affections analogous to infectious diseases. This very fact, however, brings out more clearly the crucial distinction between man as a machine and man as a subject of infection. As a machine, he may be efficient or inefficient, well operated or ill operated, and this all quite apart from the existence of actual defect or disability. Contrariwise, as a machine he may suffer initial defects or encounter accidents or develop internal disruptions, all quite apart from his intrinsic efficiency or inefficiency and quite apart from the skill with which he is operated. But as a subject of infection, man is merely a soil more or less well suited to the growth of certain small plants, or animals.*

The most valuable production of the state is its citizens, and the state exists only to insure life, liberty, and the pursuit of happiness to them. As the automobile maker insists, *for his own sake*, on (a) giving instructions and (b) correcting defects; so the state should, *for its own sake*, (a) instruct parents and (b) remedy children's defects, perhaps also the defects, disabilities, and diseases of adults. Certainly, every state should provide at least—

Education for parents in the personal hygiene of children, i. e., the care and operation of their children's bodies as machines; and educa-

*The fact that in their growth these little invaders from without "mess up the works" and make trouble, as much as would disruptions originating wholly from within, should not conceal the radical difference between the sources and causes of defects, disabilities, and non-infectious diseases on the one hand, and of the infectious diseases on the other. The former may develop in any mechanism; the latter only in those mechanisms which furnish a suitable soil for the growth of the extraneous invaders. To prevent the former the machine must be well built and of the best stock, must be scrupulously watched for defects, must be constantly overhauled, and must be cared for and operated in the most skillful manner. To prevent the latter the mere exclusion of the invaders is all-sufficient.

tion also for children in the physical care of themselves.

Supervision, not only for the mere detection, but also for the remedy, of initial defects, and should provide this early in life, certainly not later than the beginning of the compulsory-education course.

Supervision of children at least throughout school-life for the detection, *and remedy*, of such defects, disabilities, or diseases as may develop during that period.*

The supervision of infectious diseases.

THE PRESENT SITUATION

But of all the manifold duties of the state to the citizen, only one of those which can be clearly shown to bear directly on his bodily welfare, has been as yet really recognized fully here—only one rests on definite precedent authorization and organization, the supervision of infectious diseases. The personal hygiene of the citizen (*apart from the infectious diseases*), and the *remedy* (even, until lately, the mere *detection*) of his defects, disabilities, or non-infectious diseases, have been regarded (except in the case of the pauper, the criminal, or the insane) as of little or no interest to anyone but himself. And this, notwithstanding that all his material surroundings, and all his relationships, business and social, have been of acknowledged interest to the state from time immemorial.

Why this apparent negligence? First, because material surroundings are property, and property has always had precedence over persons in almost every relation; second, because, in the

*It is difficult to see strictly logical reasons why such supervision should end with school-life. Germany and England are experimenting with the medical supervision of adults.

special relation to disease, the old public health taught that the citizen was a result of his surroundings, and even in the infectious diseases this fallacy ruled, as has been abundantly shown.

Of course, the state is concerned with man's surroundings and relationships. It must consider, plan for, and carry out measures for his comfort, convenience, safety, pleasure, and happiness, as well as merely for his health. The state exists to do for its citizens co-operatively, hence economically and authoritatively, all those necessary things which the individual could do only by great sacrifices or perhaps not at all. But to believe that the securing to the individual of every possible advantage in all directions is the duty of the state, is not necessarily to believe that every item of this program should be carried out by health departments. To hand over to any one subdivision of the government control both of man and of his surroundings, would be to hand over to it all the functions of government. At once, subdivision of these activities would be necessary and these subdivisions would necessarily pattern after those of the present government. Hence such a "readjustment" would merely replace existing governments, not add to their existing efficiency.

The secret of successful organization is the parcelling out *along natural lines* of all the different activities which are to be co-ordinated to one great end. It is upon the shrewdness with which the subdivision into logical natural groups is done that the securing of smoothly-running co-ordination depends. Certainly, one most logical grand division of any government would be that which should deal with man apart from his surroundings; and one most logical subdivision

of that unit should deal with his bodily welfare as distinct from his mental, moral, or other welfare.

Using the automobile parable for guidance, such a "Commission on Bodily Welfare" should deal with—

Item 1. The education of *every citizen* in personal hygiene.

Item 2. The supervision of *every citizen* for detection of defects, disabilities, and disease.

Item 3. The treatment of *every citizen* for all defects, disabilities, and diseases detected.

Item 4. Finally, that function to which the automobile analogy does not apply, i. e., the supervision of that small group of citizens, the infectious persons.

How closely do we in Minnesota approximate this ideal?

Proper education of every citizen in personal hygiene (*apart from the infectious diseases*) is scarcely even foreshadowed by existing efforts.

Medical supervision (*apart from the pauper, the criminal, and the insane*) is limited to a small portion only, of the school children only, in a few cities only; and does not pretend to remedy defects, but only to detect them.*

Treatment of disease (*except for the pauper, the criminal, and the insane*) is a matter of private purchase or of private philanthropy, usually the private philanthropy of the private practicing physician.

The supervision of infectious persons is alone really established, authorized, or organized as a recognized duty of the state throughout the

*About two-thirds of the children of the state live and attend school in rural districts where medical supervision for defects is hardly yet even contemplated.

state, and then only so far as the protection of others is concerned. We have not yet reached the treatment of the sick even though they be sick of infectious disease.

But the mechanism for even this function, although it is actually in existence, actually organized, actually authorized, actually operating, and has behind it long years of legal precedence and the support of public opinion, is sadly undermanned, and under-equipped,—merely a skeleton.

IMMEDIATE POSSIBILITIES

It is true that even those advanced states which have organized, in part or in whole, the above outlined operations, organized the control of infectious disease far earlier and more completely than they organized any of the others. They have done so in accordance with a general rule, which governs all mankind, namely, that of doing first the simplest, crudest, and most obviously necessary thing.

But it is also a matter of fact that the supervision of infectious persons differs essentially in principles, methods, object, extent of application, and destiny from education in personal hygiene, medical supervision for defects, or medical treatment. The latter are obviously, directly, and immediately to and for the benefit of the individual who is educated, supervised, or treated. In principle, they are gifts of the state to its individual citizens. But the former is not to the benefit, usually rather to the temporary detriment, of the individual who comes under its operation. Its benefits are wholly to others, and even so do not add anything to their welfare, but merely prevent subtraction from it.

The methods of the infectious-disease super-

visor are necessarily those of the detective and the policeman, not those of the educator or the physician. The object he seeks is prevention, not construction or even repair. He does not deal equally with every citizen for that citizen's good, as does the educator or the physician, but he ferrets out a few individuals who must be restrained for the good of the others. His destiny is, if successful, to eliminate the only reasons for his own official existence, while the educator and the medical supervisor for defects will always continue to find in each new annual crop of children a new and constantly increasing field for their services.

In brief, the first three activities are, like boards of public works, constructional in essence. Supervision of infection is like the work of fire departments, conservative merely.

But although we may accept these four items as entirely proper for ultimate realization, we must acknowledge that the present public-health situation cannot be met merely by handing this outline to the state and asking that it be put into effect. Still less can it suffice to hand the outline over to existing boards of health or health departments, notwithstanding that these constitute, by tradition and precedent, practice and organization, that arm of the government to which has been assigned the only activities of the state in relation to bodily welfare, so far seriously or widely recognized.

Health departments in general are undermanned, under-equipped, continually distracted with futilities. But if expanded, their distractions eliminated, and their faces set sternly to the reduction of disease and death, they could

not at once assume all the items of this program. Why?

Item No. 3 we may dismiss from consideration at present. It is out of the question for many years to come.

For Item No. 1 the basic necessities,—knowledge, authority, and organization,—are all lacking. For Item No. 2 knowledge, authority and equipment can be had, it is true, although they may not be immediately available. For Item No. 4 only have we *now* all three,—knowledge, authority, and equipment, although the latter only in outline.

EDUCATION

Furthermore, it is true that Item No. 1, the education of every citizen in personal hygiene, cannot be carried out properly (*apart from the infectious diseases*) by *any* organization at the present time.

Why? Because such education requires, first, the knowledge, digestion, and formulation of the facts to be taught; and, second, the training of those who are to do the teaching.

But the best of us do not know personal hygiene (*apart from the infectious diseases*); that is, we do not know how to care for and operate the human body as a machine. What, for instance, should be taught concerning diet when Chittenden of Yale and Wiley of Washington promulgate exactly opposite views? What should be taught concerning ventilation when the whole subject is in absolute chaos? What should be taught concerning clothing, sleep, exercise, and fatigue?

Our physiologists study the normal body, but more in relation to disease than to health. Our vital statisticians seek the factors of morbidity,

not of physical perfection. Even the famous Federal "poison squad" sought to determine what is bad for people to eat, not what is good for them. All of these things are, of course, useful, excellent, even essential to know; but they do not teach us personal health, they teach only the avoidance of actual disease.

The truth is, that, as regards human bodily welfare, personal hygiene proper, we know but one factor, that is disease. We know disease because we have studied it. We know also the "personal hygiene" of farm animals because we have studied the "personal hygiene" of farm animals, at a cost of twelve million dollars a year. But we know nothing of the personal hygiene of human citizens, because we do not study it at all, except the hygiene of infants. We shall never know the personal hygiene of humans, apart, always, from the infectious diseases, until we do study it—until we put as much time, pains, and money into it as any agricultural experimental station in any state puts into the study of the "personal hygiene" of cows and hogs.

There is, however, no real reason why health departments should teach personal hygiene at all, *apart from the infectious diseases,* any more than that they should teach personal morals or personal finance. Health departments have no peculiar knowledge of the one any more than of the others; and if they had, there are professional teachers much more competent and possessing far greater facilities than any health department.

Even education concerning infectious diseases is not strictly health-department work. This, like personal hygiene, should be taught seriously

and systematically in the public schools. Ninety per cent of the population never enter high schools, and only one per cent reach the university. Whatever of personal hygiene or prevention of infection the citizen should know, must be taught in the grades or miss its mark. No amount of desultory pamphleteering or lecturing by health departments can ever take the place of properly conducted grade courses. Unlike courses in personal hygiene, about which we know next to nothing, courses in the prevention of infection could be established at once, since we know almost all about it; but it is no part of health-department work to conduct such courses. Health departments are police bodies, not preachers or teachers. They may well, it is true, educate the educators. There is no reason why they should educate the public, except the failure of the professional educators to do so.

MEDICAL SUPERVISION OF SCHOOLS

Medical supervision of school children, so far as it deals with defects, deals with non-transmissible conditions. Medical supervision, so far as it deals with infection, deals with transmissible conditions. The latter therefore detects links in the chain of the ramifying threads of infection throughout the community,—a ramification, the threads of which unquestionably should be in health-department hands.

But medical supervision for infectious disease in school as a means for general control of all infections has had a singularly exaggerated importance attached to it. Only one-half of the state's children attend school in any one year, and even the school child passes but one-ninth of each year in school. Were health depart-

ments alert in their familiarity with, and efficient in their control of, the ramifications of the chains of infection outside of the schools, they would locate and supervise the infective child before, not after, he had infected school children; before, not after, the medical supervisors for defects discovered him in the class-room.

But the fact that medical supervision for defects *need* never encounter infection in that one-fourth of the total population which is contained in the schools, if health departments do their work properly in the other three-fourths which is outside of the schools, carries, alas, no guarantee that infective children will not, for a long time to come, occupy a share of the medical school supervisors' attention. Especially will this be true in rural districts where nearly two-thirds of the children secure their education and where health-department organization and equipment is, practically speaking, non-existent.

Hence, whatever may be our individual views with regard to the ultimate relation of medical school-supervision for defects to supervision of infectious persons, we need not blind ourselves to the fact that ideal conditions are far in the future, and that immediate necessities call for immediate adjustments which may be temporary or not, depending on future developments.

Me~~dical supervision for~~ defects and medical supervision for infection are now, and, for some time to come, must remain, so interdependent that the closest co-operation, even, in the rural districts, amalgamation, will be necessary. Such amalgamation should be under health departments, wherever that is possible, rather than under school boards.

First, because school boards have no authority

from tradition, by precedence or by law, as have health departments to follow, outside of the schools, the ramifications of infection of which the infective child in the schools constitutes but one link, nor even to follow that one link back to its home.

Second, because school boards have no information or authority concerning the full half of the children who are not of school age nor concerning any adult except those directly connected with the schools.

Finally, amalgamation in the rural districts is essential for one great reason, if for no other, and this reason is that if we do not combine both functions in one, in the rural districts, we shall not secure either function there at all.

SUMMARY

Non-infectious diseases, disabilities, and defects constitute a field for governmental attention as great as or greater than do the infectious diseases.

There are no theoretical reasons why governments should not concern themselves with the greater (the non-infectious group), as well as with the lesser (the infectious group).

Public-health activities in their very broadest conception would include all the functions of government, since there is nothing of interest to man, from high finance to municipal playgrounds, which has not some relation to health.

But an administrative system so vast as to control all human activities related to health, would merely replace the government, and would itself be necessarily subdivided, much as existing governments are now.

It is not difficult to outline a logical program

for one branch of any government, a branch which should deal with the bodily welfare of man and include hygienic education, medical supervision, medical treatment, and the suppression of infectious diseases.

But there are many practical, as well as theoretical, reasons why health departments will not, indeed cannot, proceed at once to put this program into execution. Concerning education in personal hygiene, apart from the infectious disease, agreement as to the basic facts to be taught has yet to be reached. As to the second and third items, organization, broad precedent, and broad authority are all lacking.

Concerning the infectious diseases, and concerning them only, are the paths clear and the duties plain.

The "instant need of things" is to do faithfully and well that one duty which we fully understand, the only one for which organization, authority, tradition, precedent, and the support of public opinion are already in our hands, i. e., the abolition ~~of infectious~~ diseases. To this end, the embryonic beginnings of the medical supervision of every citizen—that is, medical school-supervision—should lend its aid, especially in the rural districts.

But until we have accomplished this—the simplest, easiest, crudest of our obvious and recognized duties—that one which lies right at our finger-tips, we cannot very well ask that the Nation should hand over to health departments all its great problems of life, death, health, and national development.

To achieve the abolition of infection we must strip for action, discard all useless armor and antiquated weapons, cease desultory bombard-

ment at leisurely long range of the enemy's outlying domains, and personally seek, with well-shortened weapons, the enemy himself (infection) in his real stronghold (the infective person).

Chapter IV

THE OLD PRACTICE AND THE NEW

EPIDEMIOLOGY

The previous chapters were designed to clear the way for the constructive program which the following articles will seek to set forth.

The conclusion so far reached is that the chief immediate duty of official public health is the abolition of all the infectious diseases. For this great enterprise, both scientific principles and scientific practice are essential. The new public health principles have been outlined; the new public health practice remains to be explained.

Public health practice in handling infectious diseases may be traced through three distinct eras: past, present, and future.

Past, or era of "general sanitation."—The practice consisted in a strenuous campaign of "general cleaning up"; an orgy of sweeping, burning, scrubbing; an ecstacy of dirt-destruction, individual, household, municipal.*

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*The reader is begged, pleaded with, besought, not to repeat at this point the wearisome old gibe, Then you want us to live like pigs? If not, why do you condemn "general sanitation?" We do not condemn "general sanitation," or cleanliness, or order, or decency. We simply present the scientific fact that these things do not greatly prevent, nor does their absence produce, infectious diseases. They have a thousand advantages, but not this one. Honesty does not protect against lightning; yet this fact can not affect a single honest man, nor does its statement detract from honesty in the least. And so with "general sanitation." It is **specific,** not "general," cleanliness that prevents infection.

This "general sanitation" was a true old-style shot-gun prescription used indiscriminately, for any outbreak of any disease. No distinction of *sources* from *routes* of infection was made; indeed, that a distinction existed was hardly recognized, and, looking back, it sometimes seems that even the most obvious relations of cause and effect often were ignored.

Present, or era of "specific sanitation."—The practice is deliberately to analyze the particular outbreak of the particular disease concerned; speedily to determine thus the exact *route* of infection actually responsible; and promptly to abolish or block that route.

Future, or era of "supervision of sources."—The practice, so far as it is possible to forecast it, will be the location and supervision of the *sources* of infection (infected persons) before, not after, they gain access to *routes*, so in time eliminating infectious diseases entirely.

Thus it is seen that public health practices, past, present, and future, form a series, descending from the general to the particular, from the surroundings to the individual, from (a) the random application of blanket measures, through (b) a specific detection and a specific correction of a specific bad condition, to (c) the actual forestalling of the development of such conditions at all.

COMPARATIVE METHODS

To make clear this most important matter of public health practice, illustrations are offered, exhibiting the public health practices of the different eras in action in the face of a typhoid fever epidemic, typhoid being selected because abolishing this one disease alone involves every

modern public health principle, and, in some form, every modern public health practice.

The end sought was, is, and always will be, the same,—to stop the spread of the disease.

But the methods of the different eras contrast widely.

In the past era of "general sanitation," a typhoid epidemic was met by a vigorous attack on dirt, damp cellars, dust, disorder; on garbage, manure, dead animals, weeds, defective plumbing, and stagnant pools; cobwebs were cleared away; windows were opened to "let in the blessed sunshine"; preachers preached cleanliness; teachers taught bathing; health officers limed back alleys and whitewashed outhouses. Human nature demanded "action," and "action," of a kind, was supplied.

We know now, what they did not know then, that typhoid infection is carried by water, food, flies, milk, and contact, and that "general cleaning up" could not remove infection from polluted water-mains, or purify a contaminated milk supply; could not stop the eating of infected food or eliminate contact infection.* The only form of typhoid which "general sanitation" could greatly affect was that due to flies.† But

*Contact infection is the infection which radiates directly from the infected person through nose and mouth and bladder and bowel discharges. The hands of the infector and of his associates are the chief carriers of all these discharges, although mouth-spray and sputum also act in many diseases. Things directly infected by these discharges are also dangerous, but practically only while the discharges remain fresh and moist. The radius of action of contact is usually small; it compares with the radius of action of water, food, flies, and milk somewhat as a bayonet with a gatling gun in a general melee. But contact infection in the long run is more deadly than other routes, for to each one such "gatling gun" there are many "bayonets."

†We do not now use "general sanitation" even for fly outbreaks. From this old shot-gun prescription we have eliminated all the ingredients but one, that one which alone was active. In fly outbreaks we exclude flies from infected discharges, and (so far as the primary outbreak is concerned) then stop. So does the outbreak.

of course the fly was not then known as a route of infection in typhoid, so that even the results that "general sanitation" secured were secured largely by accident, i. e., by the unknown conjunction of an unrecognized cause with an unpremeditated cure.

The present era of "specific sanitation" began a decade or so ago. Water, food, flies, and milk have been fully recognized as the main public routes of typhoid infection; contact, especially of late, as the great private route. Outbreaks have been met by finding the particular route involved, and by abolishing or blocking that route. But even in this era, the earlier practice for the attainment of this end differed fundamentally from that of today.

The earlier epidemiologists† of this era argued thus: "Water, food, flies, and milk are the known public routes; usually some one of these routes is responsible in each outbreak. Therefore, to find the responsible route in any given instance, flood the stricken community with trained inspectors; analyze the water supplies; investigate the milk supplies; go through the markets; delve into the provision stores; estimate the number of flies, and locate their breeding-places; survey the back alleys and out-door toilets; plat all results on maps; interview the city engineer, the fire marshal, the meat and milk inspectors, and examine their official records; secure the morbidity and mortality records of the board of health; study all available meteorological, topographical, geological, and other data; in brief, probe, dissect, tabulate, collate, and compare all possible *physical* information concerning the community. Under such inquisi-

†Experts on epidemics.

tion the guilty route of infection can scarcely escape detection.")

For these methods it must be said that they were scientific, logical, and exhaustive; but they were terribly laborious and generally exceedingly slow. Of course it sometimes happened that the guilty route of infection was stumbled on at once; and almost always this end was reached sooner or later, too often, however, only after weeks, months, or even years of effort. Their ponderous slowness took these methods out of the class of effective emergency measures, and this was recognized even then, for typhoid investigation was not considered a matter of haste, in initiation or in execution.

These earlier methods paralleled somewhat those which we might suppose an amateur hunter to use, if he were commissioned to find a certain sheep-killing wolf. Confronted with this problem, the amateur might, not unreasonably, flood the surrounding mountains with assistants, instructing them to find all the existing wolf-trails, and to follow each such trail inward towards the slaughtered sheep until satisfied that it did, or did not, actually lead to them.

The methods of today are the exact converse of these. Instead of finding in the mountains and following inward from them, say, 500 different wolf trails, 499 of which must necessarily be wrong, the experienced hunter goes directly to the slaughtered sheep, finding there and following outward thence the only right trail,—the only trail that is there,—necessarily the trail of the guilty wolf.

THE NEW EMERGENCY EPIDEMIOLOGY

The epidemiologist of today, called to a typhoid-stricken community, at first pays no at-

tention to the physical condition of the existing possible routes. It is sociological data, not physical, that he needs at this stage. He knows that, counting the wells, the toilets, the milk supplies, etc., there may be 500 of these possible routes; but he does not go to see them, nor even the pumping-station or the sewage-outfall. He goes, hot-foot, straight to the "slaughtered sheep"—straight to a patient's bedside. There, in thirty minutes, he reduces the 500 possibilities to, say, 10, i. e., to those encountered (a) *by this patient** (b) *at a certain time* (the date of his infection). These 10 are carefully listed; but the epidemiologist does not investigate even these 10. He goes, instead, straight to another bedside and lists there the, say, 10 routes that constitute the possible routes for this second patient; but he does not investigate the routes on this list either; *he merely compares the two lists.* Why? Because the one guilty route must be on *both* lists. Thus if both lists show the same water supply, that water supply remains a possible guilty route; but, if not, *water is eliminated.* If both lists show the same milk supply, that milk supply remains a possible guilty route; but, if not, *milk is eliminated.* Discarding thus the routes not common to both lists, 5 routes, say, still remain. At the third patient's bedside these 5 are reduced by similar treatment, to say, 3. So the search goes on until he either locates the one main public route common to all or proves that the outbreak is not due to such a public route at all, but to the private routes extending directly from person to person, i. e., to contact. Often in twelve hours of such work,

*Of course imported and secondary cases are not used for this purpose, and at this stage the epidemiologist is most careful to eliminate all such from his tabulations.

generally in twenty-four, almost always in thirty-six, the evidence is conclusive. The guilty route stands out convicted; for it is found on every list, and the innocent routes are exonerated, for they occur only on some.*

Now, at last, and not till now, does the epidemiologist deal directly with the route of infection thus indicated, examine it to find just how it is responsible, and thus provide the initial data for its remedy.†

It is at the point when the guilty public route is shown (if public route there be) that the epidemiologist, so far as this public route is concerned, steps out, and the bacteriologist, the chemist, the sanitary engineer step in; one, or any two, or all three, as conditions may require.

But detecting and demonstrating the guilt of a main public route, when such is involved, by no means ends the epidemiologist's duties. The work outlined so far is required (in Minnesota)

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*Obviously this method fails if there be but one patient, for then comparison of lists is of course impossible; but single cases usually prove to be imported or from contact. Also it may happen that even three or four patients do not furnish sufficient data to narrow the possible routes to one; obviously, the more patients there are the more conclusive the results. But even when only a few patients exist, this method reduces the number of routes to be investigated to say, 10, often to 2 or 3, an immense reduction from the original 500.

†To those who are not familiar with modern public health work, this account may seem incredible or at least exaggerated, yet these are the regular procedures of emergency epidemiology wherever they are understood today. Records of such work in Minnesota for years back are open to all enquirers. Moreover, the above account has pictured the epidemiologist working under a most disadvantageous condition, i. e., in complete ignorance of the community he deals with, except for what he learns during the investigation itself. If previous familiarity with the affected community exists, the main public route of infection can often be determined without leaving headquarters, provided merely that correct data as to the number, location, and dates of infection of the cases are submitted. Of course such "long-distance epidemiology," wonderfully accurate though it can be made, does not compare in reliability or in finish of detail with actual personal investigation on the ground.

chiefly in typhoid outbreaks; and then chiefly in those typhoid outbreaks which are derived from water, food, flies, or milk. The work still to be done is required in *all* typhoid outbreaks, whether initially derived from these public routes or from contact; moreover, it is called for in the majority of outbreaks of all the *other* infectious diseases, because the majority are usually contact outbreaks at all stages. That work is *the prevention of further spread by contact.*

To understand this clearly, it must be remembered that under present conditions every typhoid, or other, epidemic which begins from some one public route (water, food, flies, or milk) soon presents two distinct parts; the primary outbreak, consisting of those persons who received their infection from that public route, and the secondary outbreak, consisting of those persons who later, by the private routes of contact, receive their infection directly from the first set. Those typhoid, or other, epidemics which *begin* from the private routes of contact do not, of course, present a "primary" outbreak at all. They are, so to put it, "secondary" outbreaks from the outset.

The search for a public route is therefore only the first step in subduing any epidemic. If such route exist, this step, by finding it, provides for getting rid of it, which prevents the infection of any more persons from that route, and so ends the primary outbreak. But this first step by no means ends the epidemic as a whole. for the persons already infected from that public route constitute each one a source of further spread by contact, a spread which, of course, must also be prevented. Obviously, epidemics which are contact epidemics throughout, necessarily present

an identical problem from this standpoint, for every existing infected person, whatever the route of his infection, is a separate danger, and each requires supervision.*

FINDING THE UNKNOWN CASES

How does the prevention of contact infection depend on epidemiology? Cannot the spread of infection by contact from *known* cases be guarded against by the attendants (nurses and physicians) which each such *known* case necessarily has? True, and were these *known* cases the only danger-points proper attention to preventing spread from them would be all-sufficient. But the *known* cases usually form but half of the danger-points because only half of the dangerously infected persons become *known* cases. The other half consists of "missed cases" (mild, unrecognized, and concealed cases, early cases, and, later on, convalescing cases) and of "carriers." (The "carriers" are infected persons, capable of infecting others, but not themselves made ill by the disease germs which they nevertheless carry and distribute.)

Missed cases and carriers, *unless especially sought for,* are, and remain, unknown and unlocated; they have no known attendants to whom the prevention of spread of infection from them

*In earlier days the fallacy that typhoid fever patients could not directly infect their associates—in brief, that typhoid fever was not contagious—was responsible for the long-delayed recognition of secondary typhoid outbreaks, even after the origin of primary outbreaks had been learned and methods of dealing with them perfected. We know now that abolishing or blocking a primary route is but half the story. The primary cases, if neglected, may continue to infect other persons by contact, and these again others, ad infinitum. Such secondary outbreaks may extend slowly for months or years and yield cases equaling or exceeding in number those from the primary outbreak. The "endemic typhoid" of some localities is at times an unrecognized, slow-moving, secondary outbreak.

can be entrusted; they generally do not know themselves to be infected; and, if ignored, they are more dangerous, because inevitably unguarded, than the known cases, for, being known, the latter can be guarded.

This problem, the finding of missed cases and carriers, is solved by an epidemiological procedure which, while less spectacular, is far more widely useful than that of finding public routes, because it applies, not alone to contact-typhoid outbreaks, but to all contact outbreaks, that is, to all infectious diseases, from tuberculosis down. Were the ability to find *public routes* of infection in water, food, fly, and milk outbreaks the only virtue of epidemiology, its services could have no value in the great mass of infectious disease for the great mass arises chiefly by contact. It is the ability to find the *private sources* of infection in *contact* outbreaks that makes epidemiology the pivotal factor of modern public health.

This location of missed cases and carriers in typhoid, and other, outbreaks, is called concurrent epidemiology, and is well worth thoroughly understanding.

SUMMARY

Modern public health practice for the control of infectious diseases consists, not in the *physical surveillance* of whole communities, but in the *sociological study* of the *infected persons* in them.

This practice is best illustrated in the modern handling of typhoid fever epidemics, because this disease is all-inclusive, i. e., it travels by all four of the great public routes (water, food, flies, and milk), as well as by the private fifth route,

contact; also because typhoid is an intestinal infection and, of all the infectious diseases of the temperate zone, the intestinal infections *alone* travel by *all* of these five great routes.

A typhoid epidemic is approached, as is any other epidemic, first, to determine if any public route of infection is involved, and, if so, what that route is and how it operates, thus finding how to stop it; second, to determine the private routes and *sources* of the contact outbreak which, sooner or later, exists in all epidemics, whether the original route be a public route or not.

To the epidemiologist, the public health detective, falls both these crucial tasks. It is his function to find those underlying facts which alone can form a sound basis for real remedial measures.

How he performs the finding of *public routes* has been described; the finding of *private routes* and *sources* will be described later. In both procedures the initial step is the same, namely, the investigation of the known cases. By seeing and questioning *known* cases, or their immediate relatives and attendants, the epidemiologist can classify them into native and imported. The native cases, since they alone originated in the community under investigation, are further classified into primary and secondary cases. From the histories of the primary cases, if such there be, he learns the public route. From *all* the cases, imported, primary, and secondary, he obtains the data needed for the next step.

H

Chapter V G. F.

THE NEWEST PRACTICE

CONCURRENT EPIDEMIOLOGY*

The preceding chapter outlined the first step in the modern handling of a typhoid fever epidemic, typhoid fever being selected because its proper handling illustrates best the principles and practice of modern public health work.

The first step is the discovery, by the methods of *emergency* epidemiology, whether water, food, flies, milk, or contact be the original main route of infection. The second step, to be outlined in these pages, is the location, by the methods of *concurrent* epidemiology, of all the infected persons (known cases, missed cases, and carriers). These are located because each, regardless of the original route by which he himself became infected, forms a new center of infection for spread by contact.

It was further pointed out that neither emergency epidemiology nor concurrent epidemiology were limited in their application to typhoid fever; and that the ability of concurrent epidemiology to handle properly contact typhoid outbreaks, whether contact be the secondary or primary route, is a conclusive demonstration of its ability to handle all other infectious diseases, since these others, while spread by public routes to some extent, are, in the

*__Emergency__ epidemiology is the epidemiology required in outbreaks from single great routes,—water, food, flies, milk. __Concurrent__ epidemiology is the epidemiology required in contact outbreaks, i. e., outbreaks from multiple private sources. Emergency epidemiology is rapid and spectacular; it is played hard, against time, to save large groups of people. Concurrent epidemiology is relatively slow and plodding; it ferrets out, one by one, the individual persons whose infection threatens families or small groups. Emergency epidemiology will disappear when the great routes are properly protected. Concurrent epidemiology will greatly develop; it is the most powerful and practical weapon yet devised for **the abolition of the infectious diseases.**

mass, contact infections chiefly. No dependence on the argument by analogy from typhoid fever to other diseases is needed, however; for these other diseases are now and have been for years past handled successfully by these very methods.

Most persons contemplating the problem of finding missed cases and carriers for the first time, pronounce it impossible; then suggest, as the only solution, a house-to-house canvass of the whole community, hastily adding that of course such a measure is quite impractical. As a matter of fact, the public health detective does at times use, and use successfully, exactly that "impractical" measure,—the house-to-house canvass. This house-to-house method is used in primary outbreaks from public routes, to locate *unreported* primary "known cases," and also to locate primary missed cases and carriers. It is necessary in such primary outbreaks because the distribution of *primary* missed cases and carriers. as well as of "known cases," is co-extensive with that of the guilty route. There is no other guide to their location, and therefore the whole distribution of the guilty route must be searched. But the need of such a canvass *of a whole community* arises here only in typhoid or other infectious intestinal outbreaks; and then only when the infection is spread by a route *common to the whole community,* and therefore practically only when the guilty route is a public water supply. In milk outbreaks, those who did not use the guilty milk need not be examined; and a similar statement is true also regarding food outbreaks. Fly outbreaks rarely affect a whole community unless the community be very small; and in small communities of course a general canvass is not difficult.

In the majority of epidemics, and because the

majority of epidemics are due, not to great public routes, but to private contact, the finding of missed cases and carriers does not require even a partial house-to-house canvass. This is true of typhoid, and other, *secondary* outbreaks (which are contact outbreaks) as well as of the great majority of all outbreaks (since the majority are contact outbreaks only.

The reason why missed cases and carriers can be found in contact outbreaks without a house-to-house canvass depends upon a fact of which the true significance is not fully appreciated outside of epidemiological circles. It is this: such missed cases and carriers are not distributed at pure, blind random anywhere and everywhere throughout the community. *They occur in certain groups—and these groups can be located because they betray themselves through their connection with known cases. Hence the location of known cases locates these groups also.**

This most important epidemiological principle is called the principle of *zones of infection*. It is the cardinal principle of concurrent epidemiology.

The principle of *zones of infection* was first clearly recognized in diphtheria epidemics, and its development and demonstration as a practical working rule depends, primarily, on diphtheria investigations; but both principle and practice have now been established for all the well-studied epidemic diseases.

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*It must not be supposed that these groups are confined to families, immediate neighbors, etc. Their true basis is sociological relationship, not mere physical propinquity. In a single scarlet fever outbreak originating in one community Dr. A. J Chesley found the related sociological groups distributed in 3 states, involving 3 cities, 2 villages, and 24 townships in 10 counties. The Mankato typhoid fever outbreak of 1908 affected over 40 points outside of Mankato.

The epidemiologist,† in putting this principle into practice, locates first the known cases, and then searches the zones of infection, which they indicate, for missed cases and carriers. The details of this search vary with each disease and are too technical for consideration at this time. Detective methods are used, illuminated by expert technical knowledge of each disease, its natural history, and the methods of recognizing it, laboratory and clinical, at every stage and under all disguises. Suffice it to say that the finding of missed cases and carriers, as well as of known cases,—that is, of the very framework of the ramifying threads of the infectious disease,—is a problem not only solvable, but already solved, and already reduced to a routine basis. As an art, this concurrent epidemiology is somewhat more arduous and time-consuming than the art of emergency epidemiology, but it is thoroughly practical and has been successfully followed for years past all over this state, in an average of two to three epidemics every week. The visiting nurse in "concurrent epidemiology,"

†It must be evident that those private practicing physicians who are not health officers, cannot, for many reasons well understood by the profession, do epidemiological work, emergency or concurrent, except in overwhelming outbreaks, where ordinary conventions and social relations are temporarily foregone. Even those private practicing physicians who are also health officers, encounter difficulties and obstructions, ethical, social and conventional, which professional epidemiologists, who are not in private practice, do not meet. Hence in all outbreaks the physician finds that his most valuable functions consist in treating the sick and in advising protective measures to those who apply to him. Physicians also often combine, very successfully, to publish material or give public lectures of instructions during epidemics. But, after all, the chief service which the physician can render to official public health is the reporting of **known cases.** Known cases, as has been shown, are the basic datum-points for emergency epidemiology, i. e., for the finding of the routes of infection; and they are even still more important in concurrent epidemiology, i. e., in the study of the zones of infection. Epidemiology is greatly aided when the physician performs thoroughly this, his primary, public health duty.

can be made a most valuable and efficient aid, to say nothing at present of the other and even more indispensable services in other directions which are within her especial province.

This principle of zones of infection applies to tuberculosis just as to any other infection spread by contact; indeed, the location of missed cases in tuberculosis (carriers in tuberculosis are hypothetical to date) offers less difficulty to modern epidemiology than the same problem in other infectious diseases.

FUTURE APPLICATIONS

So much for past and present practice.

Turning now to the future era of "supervision of sources," the principles and practice already described pave the way for appreciation of the probable developments. In reconsidering the wolf metaphor already outlined, everyone will ask, and wisely, Why wait until some sheep are killed before we protect the others? Why not patrol the known routes by which the wolves reach the sheep; or, better, build wolf-proof folds; or, best of all, teach the sheep to protect themselves—to fight the wolves or at least to dodge them?

Those who believe that infectious disease can be warded off, in the face of infection, by diet, *

*A most important exception to the general statement that proper diet in itself cannot prevent the development of infection provided infection gains access to the body should be recorded to cover the case of nursing infants. It has long been noted that breast-fed infants, during the period that they are so fed (but during that period only) are, practically speaking, immune to many infectious diseases. This is so true of scarlet fever and measles, that in such diseases no great concern need be felt for such an infant, even though the mother herself have the disease. In diphtheria, a nursling to some extent shows a like immunity. In smallpox, this is not true and in tuberculosis it is at most very doubtful.

That this escape of nurslings is purely a matter of the enormous advantages in nutritional value, to an

exercise, good ventilation, and "strict observance of the laws of bodily health," are those who would train the sheep to fight: would train the body to destroy all infection that may reach it. But, as we do not know how to teach sheep to fight, so we do not know the laws of health needed for this purpose if any such exist.† Such methods tested against infection have generally failed‡ so far. In that day when sheep fight wolves they may succeed. Those who believe that the sheep may be taught to dodge the wolves have much more in their favor.

Dodging infection is well understood. The physician, the nurse, the epidemiologist, handle with impunity the very sources of infection themselves,—infected persons and their infected discharges. Why not teach this art to every citizen? The principle is simple,—prevent infected discharges from entering the mouth. It is in the practising of this principle, simple as

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infant, of mother's milk over other foods has yet to be demonstrated. Nursing infants are by the mere fact of nursing less likely than are other infants to be exposed to whatever routes or sources of infection may be about, unless the mother is herself a source. But in scarlet fever and measles, at least, this is not the whole explanation. It has been suggested that the real reason lies in the transmission to the child of actual immunity-producing bodies in mother's milk. If this be so, breast-feeding in infants as a protection against certain infectious diseases combines in one operation three principles of defense; good nutrition, specific immunization and the avoidance of infection. Other forms of feeding fail to provide these defences; and usually combine against the infant poor nutrition, absence of immunization, and exposure to the five routes of infection. Great skill and care and constant watchfulness may serve in artificial feeding partially to offset these dangers; breast-feeding automatically protects against them almost without effort. Moreover, breast-feeding accomplishes in **other ways** four times the service in saving infant's lives that it accomplishes in cutting out infectious diseases. (The writer wishes to record his indebtedness to Dr. J. P. Sedgwick, of Minneapolis, for much valuable information on this subject.)

†Once more we beg our readers not to think that because building up the body cannot make it proof against infectious diseases, building up the body should be abandoned. To say that physical care of the body never made a Newton or a Shakespeare, is not to

it is, that the inexperienced person fails. A single slip may be fatal, and slips are constantly made. Moreover, to guard against those infected persons *who are not recognized as such,* means that *all* discharges must be kept out of *all* mouths at *all* times,—a theoretically possible, but, to the vast majority of the work-a-day world, a practically wholly impossible, performance. If we give up in despair the hope of excluding *all* discharges from *all* mouths and attempt to teach the ordinary citizen to recognize infection so that he may avoid at least infected discharges, we shall be attempting to make of each citizen, man, woman, and child, a highly trained physician. To teach personal defense against infection is a great thing for those who learn and practice it. As a general method for abolishing infectious diseases, it is quite hopeless; nevertheless, each citizen should have the chance to learn at least the principles.

Those who believe that infectious disease should be warded off by specific immunization have some sure ground to go upon; but the scope of immunization is at present small. These are they who would build wolf-proof folds; but we do not know how to build folds which will be proof against all kinds of these wolves. It is true we know how to build a fold which is proof against smallpox, and that is vaccination. Also we are experimenting with a fold proof against typhoid, which is antityphoid inoculation. But, alas, granting such folds are built, driving

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say that no man should care for his physical welfare. The laws of physical health, even so little as we know of them, have many virtues. Because protection from infectious diseases is not one of them detracts no whit from any of the others.

‡Tuberculosis and pneumonia are often held exceptions to this rule, but that they are exceptions is being questioned.

the sheep into them is a procedure forbidden to public health, except in Germany. In vaccination and in antityphoid inoculation the old adage still applies: "First catch your sheep."

Those who believe in guarding routes of infection are those who would patrol the approaches to the sheep. This is at least a possible method, already established as of great value in some diseases. But a consideration of the following table shows that, like immunization, its scope is limited. Its scope is broader than that of immunization, but it is not broad enough to cover all infectious diseases.

If we tabulate the different infectious diseases occurring in the temperate zone on the basis of their chief routes of transmission we find that water, food, flies, and milk are the main public routes; the many private routes we group under contact; not every route operates in every disease. Thus:

The Chief Infectious Diseases of the Temperate Zone Classified by Their Chief Routes of Infection

Typhoid fever (and other intestinal infections) are carried chiefly by	water	food	flies	milk	contact
Tuberculosis (human)* is carried chiefly by			flies**	milk	contact
Diphtheria, scarlet fever, measles, German measles, mumps, whooping-cough, smallpox, chickenpox are carried chiefly by				milk	contact
Syphilis, gonorrhea, trachoma, cerebrospinal meningitis, leprosy are carried chiefly by					contact

*Bovine tuberculosis is of course derived chiefly from the milk of tuberculous cows. In many ways this disease is best separated for administrative purposes from human tuberculosis. The carriage of human tuberculosis in milk referred to in the table is that dependent on the infection of milk by tuberculous milk handlers.

**Insignificant.

Hence water and food as great public routes of community infections carry only the intestinal infectious diseases. Flies, practically speaking, also carry this group only, the amount of tuberculosis carried by flies being small. Milk carries many infectious diseases, but contact alone carries all.

If we guard water supplies only against infection, we eliminate water-borne intestinal infections (this, so far as typhoid is concerned, would be about one-third of the total typhoid in Minnesota). We leave untouched intestinal infections carried by food, flies, milk, and contact. Also we leave untouched *all other infectious diseases.** If we guard food, as well as water, we eliminate such intestinal infections as are carried by food and water, but the fly, milk, and contact routes for these remain; so do all routes which carry the other infectious diseases.

If we eliminate flies also, fly typhoid and its congeners go, but milk and contact typhoid still remain with us. It is true that a slight effect on tuberculosis also might be noted, but nothing else is touched. If we guard milk supplies against infection,† we begin to make great strides, but *contact*, the great route of human tuberculosis and of all the other infectious diseases, including the intestinal (in Minnesota), still will operate.

The fact is that while public water, food, fly, and milk infections parallel invasion by wolves *coming from without*, contact infection parallels

*Hazen's theorem—that infected water supplies carry all the infectious diseases—is an unproved and much disputed hypothesis as yet.

†A great deal of the alleged milk supervision of today to prevent watering or to keep up the fat standard has no relation whatever to guarding milk against infection. Even the campaign for clean milk eliminates dirt chiefly. Unless especially conducted to prevent infection, it fails on this latter score completely.

the presence *amongst the sheep themselves*, of "wolves in sheep's clothing." Such wolves, because intermingled with the sheep, cannot possibly be eliminated by guarding the approaches.

If, then, the guarding of public routes can exclude only some of the infection, what remains?

The extermination of all the wolves—the abolition of the sources of infection.

If our modern wolf-hunters can find the undisguised wolves and even the wolves in sheep's clothing, *after* the sheep are slain, why cannot they find them also *before* the sheep are slain? If the very *sources* of infection (known cases, missed cases, and carriers) cannot escape our epidemiologists armed with their modern principles, why wait for an epidemic before we go after them at all?

Turn again to the table and see that if we begin operations for control with water, we must move through food and flies and milk to contact before we have included all even of typhoid; and until we reach contact, we do not begin to touch the bulk of the other diseases at all. But if we begin with control of contact, we find that *the method which eliminates contact infection necessarily eliminates the other forms also.* That method when shorn of non-essentials is the supervision of *all* infectious persons.

THE NEW PROGRAM

To drop metaphors, the new program of official public health is the abolition of the infectious diseases.

The measures for this purpose in progressive order of general efficiency, from lowest to highest, are—

1. The securing to each individual citizen continuously of his highest possible general physical health. Ideal as this is as an end in itself, it can have little effect on most infectious diseases, except indirectly during infancy, although it is supposed to be a factor in reducing tuberculosis and pneumonia even in adults.

2. The securing to each individual citizen of instruction and training in the personal conduct which he must follow in order to avoid receiving into his body the discharges of infected persons. This as a system is perfect, but the securing of the daily carrying out by everyone of the personal conduct needed is a hopeless dream.

3. The securing to each individual of continuous specific immunization. Technically practical as yet only against smallpox and typhoid fever by inoculation, and in infancy against certain infections by breast-feeding, the scope of this procedure is very limited; and it must be remembered that the public have never yet adopted even smallpox immunization, except under compulsion, to an extent sufficient to abolish even this one disease.

These three measures place the abolition of infection directly upon the individual, as though, to abolish foot-pads, we should arm each citizen and train him in *jiu jitsu;* or as though, because of one free wolf, we should put five hundred sheep in armor. The three measures which follow place the abolition of infection directly upon a very small group of experts who deal directly with the infection itself. These three measures would put the one wolf in bonds, and let the five hundred sheep go free.

4. The physical supervision of the four great

public routes of infection (public water supplies, public food supplies, flies, which are public property, and public milk supplies) to exclude all discharges from them. The principles are well understood, but, in practice, systematic application usually is lacking. (Physical supervision of such public and private surroundings as, by their effect on conduct, may bear on the operation of the fifth and greatest route of all, i. e., contact, is necessarily at present more a matter of education than of official action, especially where private surroundings are involved.)

5. The physical supervision of all *known infectious cases* to exclude their infected discharges from all routes. This, thoroughly done, would make a tremendous impression on infectious diseases. But *known* cases form not more than half the sources of infection.

6. *The sociological supervision of all infectious persons.* These are *the* sources of infectious disease. Once found and supervised, infection from the human *must* stop *in toto.*

For the first three measures, education, demonstration, persuasion, are the things required; but also the abolition of carelessness, poverty, and the pressure of necessity. Knowledge alone is not enough; time and facilities to do with are needed also. To supply all these to every citizen, man, woman and child, is an ideal to be sought by every path; but an ideal that will take long years to realize.

For the second three we have principles and practice, precedent, authority, some law, and the hearty support of public opinion *in epidemics.* We need a few new laws. Chiefly we need proper organization and increased equipment;

but, more than all, the hearty support of public opinion, *continuously*, not in epidemics only.

Of all these measures, the last is certainly the most inclusive; properly done, it excludes the need (so far as abolition of infectious diseases is concerned) of all the others. It is cheaper, simpler, easier, more direct and rapid than any other, and does not "interfere" with every citizen, in every act of daily life, indefinitely, for it deals with but one small class (infected persons), and only while infective; and it deals, even with them, merely to the extent of preventing the spread to others of their infected discharges.

Chapter VI

INDIVIDUAL DEFENSE

PUBLIC DEFENSE AND PRIVATE

The preceding chapter distinguished sharply those things necessary to *escape* disease, which individuals *may* do, from those things necessary to *prevent* disease, which communities *must* do, because individuals cannot.

The present chapter will outline the former. As already indicated, these individual efforts may be made in three directions:

1. To secure high general physical health.
2. To secure specific immunity to specific diseases.
3. To avoid disease, especially infectious disease.

Efforts in the first direction would aim to build up and make palaces of the bodies in which we dwell and which, too often, are mere hovels; but, alas, the palace burns as easily as the hovel. It would be futile to seek the physical advancement of the race in order *to abolish disease.* We should seek the abolition of disease in order *to physically advance the race.*

THE PREVENTABILITY OF THE "PREVENTABLE" DISEASES

True, we should not await this abolition before seeking general physical advancement, but, unfortunately, we know as yet few practicable rules of general application, except for infants, to achieve such physical advancement. Far bet-

ter than how to secure high physical health we know how to avoid disease, at least, how to avoid certain diseases. A few of these are non-infectious environmental diseases, like scurvy and miner's elbow; and the non-infectious poisonings, like the poisonings from lead, arsenic, phosphorus, alcohol, and illuminating gas. These diseases depend upon readily recognized mechanical or physical surroundings. A change of diet in scurvy or of position in miner's elbow; stopping leaks in pipes for illuminating gas poisoning; refusal to admit the other poisons to the body—and all are abolished. These non-infectious poisons furnish but 1 in 1,000 of all deaths, except in infancy, where non-infectious intestinal poisonings furnish a large proportion.

On the other hand, the poisonings which are infectious, i. e., the infectious diseases, furnish more than one-sixth of all the deaths, and about one-half of these deaths are from one infectious disease, namely, consumption. Like the chemical poisonings,—lead, arsenic, etc.,—the infectious diseases depend on noxious materials that enter the body. But, unlike lead, arsenic, etc., the poisons which produce the infectious diseases are associated, not with a few well-known material *surroundings* and inanimate *things*, but with the living activities of many, often unknown, *persons*.

The little we know of how to achieve high health, and the much more we know of how to avoid disease, should be taught our 2,000,000 citizens of Minnesota. This huge task requires a mechanism so huge that only our huge public school system can accomplish it.*

*It is often said that practising physicians should teach health to the public. In one sense this is true. Physicians represent medicine, and medicine deals

Efforts in the second direction (for specific immunization) would aim to "fireproof" our bodies against disease, whether those bodies be "palaces" or "hovels." But such fireproofing can as yet be done only against smallpox and typhoid fever.**

Also, just as the general public will not fireproof literal houses against literal fire, despite large fire losses every year, so the general public will not fireproof their bodies against infection, even against smallpox. One hundred years of vaccination has left us in Minnesota with only 30 per cent of children under 16 years of age protected against smallpox. We shall be lucky if 10 years of antityphoid inoculation finds us with 10 per cent of adults protected against typhoid. In the absence of compulsory laws, rigorously enforced, immunization must remain a task of systematic education, reaching everyone, and this task also only the public school system can properly perform.

Efforts in the third direction would aim to shut out all poisons, including all infections, from all bodies, whether these bodies be palaces or hovels, on the principle that as no dwelling, pal-

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with disease, its cure, and its prevention. But practising engineers might as well be drafted to teach geometry as practising physicians to teach personal hygiene. Physicians dealing with their own patients, or even lecturing or writing on these subjects, do much good. Such work, however, is but a drop in the bucket, reaching only a fraction of the public and generally just that fraction which needs it least. There are over 2,000 practising physicians in Minnesota. They have not time, training, organization, or authority for the sort of teaching that will really reach all citizens; the public school system has all four, and 15,000 teachers to do it with.

Medicine must furnish the facts that are to be taught, but it is quite impossible that practising physicians should do the teaching.

**The immunity possible against diphtheria through protective doses of diphtheria antitoxin, is too short-lived for general continuous application to all citizens.

ace, or hovel can burn if fire do not reach it, so our bodies, good, bad, or indifferent, cannot be destroyed by disease if the causes of disease be shut out from them. To abolish literal fire from literal dwellings is impracticable, for fire is too useful for abolition. Disease serves no useful purpose, and its abolition is the only reasonable goal.

The exclusion of the poisons of disease, infectious or non-infectious, from the body, is the most successful preventive measure we have at present against most diseases that are preventable at all. The methods should be taught to every citizen; and for this again the public school system alone is able. Public health experts must supply the facts; it is quite impossible that they should do the teaching.*

"DODGING INFECTION"

Dodging infection rests on simple principles, already outlined. The one essential is to exclude from entrance to the body, matter from infectious bodies; i. e., in briefest practical form, for all except the venereal diseases, to *exclude from the mouth the infected discharges of others.*

To do this requires, first, the ability to recog-

*Of each 1,000 school children in Minnesota schools, 450 leave school at the end of the 6th grade work, 450 leave at the end of the 8th grade. The remaining 100 enter the high school; but only 50 graduate. Ten out of the 1,000 thousand enter the University; 5 graduate. We now teach in the earlier grades theoretical anatomy and theoretical physiology, intending thus to form foundations for later practical information. Since 90 percent of children leave at the 8th grade, this 90 percent receive the theoretical information only; they never learn its practical use at all.

This system needs inversion. We should teach the practical parts of hygiene and of avoidance of disease to the 100 percent of children; i. e., not later than the 6th grade, leaving the theoretical parts for the 10 percent that take the higher courses.

The State Superintendent of Education, Mr. C. G. Schulz, authorizes the statement that he is making plans to have these subjects taught in the public schools in the manner indicated, just as soon as arrangements can be made.

nize infectious persons; and, second, the skill to avoid their discharges.. But we cannot teach the general public, half of them children, to recognize infectious persons. If, then, we broaden the rule and teach avoidance of discharges of all sick persons, whether infectious or not, we ignore those persons who are infectious without being sick. Hence, for the non-medical citizen, the rule must run: Exclude *all* discharges of *all* persons from *all* mouths. But this is by no means so easy as it sounds.

"CONTACT"

Mouth-discharges are exchanged in the form of mouth-spray, sputum, and smears on various things, but *chiefly by smears on hands.*

Mouth-spray consists of tiny, often microscopic, drops of liquid from the mouth, thrown out in sneezing, coughing, shouting, singing, and speaking, but not in quiet breathing. The larger ones can be seen, if watched for, and they can be felt falling upon the face in face-to-face conversations. Talk, or sing, or shout, or cough, or sneeze against a mirror two feet distant, and count the drops that strike it. Then picture to yourself what happens at "teas" and "sociables"; at meals, with lively conversation going on; at school; at church. Think also of what happens when the cooks or waiters talk while preparing food, cough while laying tables, or sneeze while wiping dishes.

This distribution of mouth-spray cannot be *prevented* unless all wear masks, as modern surgeons do when operating.

But exchange of mouth-spray may be *avoided somewhat* by avoiding close face-to-face conversations, as by sitting side by side or far apart; by coughing or sneezing always into a handker-

chief, etc. Often, of course, the cough or sneeze comes too quickly or the hands are already full. It is true that the head may be turned aside; but often this spares the person in front at the expense of others, and, while coughing or sneezing into the hand prevents the mouth-spray from flying wide, the spray goes to the hand and the hand itself passes it on to the other persons later.

There is no practical method of avoiding all mouth-spray of associates, except not to have associates; but the amount of exchange may be diminished by the above precautions.

Sputum, through the spitting habit, falls upon floors, steps, sidewalks. That these deposits dry and blow about as dust is the least of the dangers, especially out of doors, for sunlight and drying disable most disease germs. Sputum follows a much more important route leading to mouths, and this route is followed, not when the sputum has become dry and dusty, but while it is still fresh and moist,—while the germs in it are still alive. This route is by way of shoes, directly into houses. There, wiped off on carpets, it awaits the creeping baby; it smears itself on the baby's fingers; and he carries it directly into his mouth. Also, in removing shoes, the owner of the shoes uses his fingers and then, too often, the owner's fingers, just like the baby's, enter the mouth unwashed. The value of anti-spitting ordinances thus becomes apparent.

But, after all, hands are the great route of exchange, and hands furnish the great route for bladder and bowel discharges, as well as for nose and mouth.*

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*Hands do not carry only infectious diseases. They are the chief routes by which lead is carried to mouths in lead-poisoning, and are also an important factor in phosphorus poisoning.

From birth to death those universal tools, our hands, go to our mouths incessantly; from birth to death we use them for every other purpose also. Hands encounter all the discharges of the body many times a day; and if not scrupulously washed on every such occasion, they carry these discharges to everything they touch, including other hands, which go to other mouths. The very handkerchiefs we advocate to cough or sneeze or blow our noses into, transfer these same discharges to our fingers, the next time that we use them.**

Then we shake hands with others, or feel the baby's new tooth. Visits to toilets, unless followed at once by careful hand-washing, mean similar transfer of the toilet discharges as well, particularly amongst children, who, remember, form half the population.

The common drinking-cup and the common drinking-pail are bad because they help to exchange mouth-discharges; the roller-towel is worse, especially when used for *half-washed* hands, because then it helps to exchange *all* the bodily discharges: but the *unwashed* hands themselves are worst of all, because the discharges they carry are undiluted and fresh and moist and warm. When strangers enter a household, they add, through mouth-spray and hands, their discharges to the general household stock; and, due to this, harvesting help, threshing crews, etc., introduce infectious disease into numerous rural families and communities every year.

Within the purview of the private citizen at home, discharges are also exchanged somewhat through *things* soiled by mouth-spray and hands,

*It has been suggested that the left hand should be used for handkerchiefs, thus leaving the right hand clean so far as these discharges are concerned.

as well as directly. Thus are contaminated dishes in laying the table, bread, cake, etc.. also pillow-cases and sheets which are soiled by mouth or other discharges from the body. The list of the things which *may* carry such discharges, is too long for itemizing here; but, in general, such *things* do not form really very important routes of transfer, except when the discharges are considerable in quantity and while the discharges are fresh and moist. Once dried on clothing, mouth-spray, for instance, is not readily set free, and when it is dry, infection, if present, dies out with fair rapidity. Just as the main public routes of discharges from the community to the family are public water supplies, public food supplies, public milk supplies, and public outdoor flies, so the main private routes within the family, apart from mouth-spray, sputum, and hands, are private water supplies, private food supplies, private milk supplies, and private indoor flies. Public supplies may or may not bring discharges with them to the family; once they enter the family, they pretty surely receive them from the family itself. So also with the private supplies of the same things: the family well may or may not be dosed with the family discharges; the family drinking-pail or pitcher almost always is; the family cow may or may not contribute discharges to the family milk-pail, but the family milker practically always does*; and later, within the family, the family milk-pitcher receives the family mouth-spray. The family food, before and even after cooking, is subject to similar contamination. The family flies moving from the outdoor toilet, un-

*If a milker talks or sings or coughs or sneezes, using a wide mouth pail, his mouth discharges enter the milk. If he milks with unwashed hands, **all** his discharges enter the milk also.

less it be fly-proof, or from indoor spittoons or slops to food, aid in the same exchange.*

Knowing these dangers is half the battle won. Against infection of public routes,—public water supplies, public food supplies, public outdoor flies, and public milk supplies,—the private citizen should not need precautions, for these the community itself should guard. But if he need them, the private citizen has against such public routes two powerful weapons: (a) exclusion from his premises of the infected route, and (b) cooking. Foods are, of course, usually cooked, even in ordinary life; water may be boiled, milk Pasteurized, and if flies cannot be excluded, the food they contaminate can be rejected or cooked again.

The public routes of infection are not difficult for the citizen to guard against, however onerous that guarding may be: the real difficulty is with the private routes, the routes of contact that carry infection within the family and also within the school, the office, the workshop, the factory. We, individually or collectively, may abolish in time the common drinking-cup and common

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*A curious perversity of human nature makes us attach undue importance to many possible but unimportant routes of discharges, like telephone-receivers, dirty money, the licking of postage stamps, etc., while we neglect the commonplace, really important routes, acting daily and everywhere, above outlined.

An example of the same thing is seen in the great anxiety expressed concerning meat as a route of infection. It seems to be remembered but seldom that meat is almost always cooked; i. e., it almost always automatically receives the very treatment we solicitously prescribe for blocking infection through milk and through water. Meat-inspection is wholly proper, to secure good meat, and to prevent the robbing of the consumer's pocket and the consumer's stomach. But all the meat-inspection in the world could not reduce our ordinary infectious diseases by one-tenth of 1 percent. Meat, as food, especially cold meat, often carries the family discharges, but disease in, or discharges attached to, meat from its sources outside the family, are in most cases destroyed by cooking.

roller-towel, but no one can ever abolish mouth-spray or hands.*

It is true that by education** we may greatly affect personal conduct, but to leave the abolition of infection in ordinary life to the personal conduct of all sorts of people, half of them children, would be as wise as to trust the destruction of infection in a water-borne typhoid outbreak to the boiling of the water by the private citizens.

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*Two million mouths, served by 4,000,000 hands, receive 6,000,000 meals in Minnesota daily. But this is not as important as are the hands that handle the meals in preparation; moreover, hands go to mouths far more often between meals than during them.

**The following rules prepared for use in the public schools at the request of County Superintendent Geo. S. Selke, Benton County, indicate the main points to be taught concerning protection from infectious diseases in the schools. They indicate also pretty closely what can be done in the home and for this reason they are inserted here.

Placard for Schools

The germs of infectious diseases are in the discharges of infectious persons. Infectious diseases are "caught" from infectious persons simply by taking into the mouth some portion, usually very small, of their infected discharges.

The Great Rules of Prevention in Schools.

1. Exclude from school all infectious persons, thus excluding all infectious discharges.

2. Since infectious persons may enter school at times despite the greatest vigilance, restrict, so far as possible, the scattering of any discharge of any person at any time in school. (This will also train the children to restrict their discharges out of school and in after-life).

a. Mouth discharges are transferred directly to and taken directly from drinking-cups, towels, pencils, chewing-gum, whistles, etc. Mouth, nose, bladder, and bowel discharges are transferred directly to hands many times daily. Hands go to mouths many times daily; therefore—

Provide individual drinking-cups, individual towels, individual pencils, individual modeling-clay, individual modeling-sand, etc. There should be a sign in every school, "Wash your hands after every visit to a toilet."

b. Sputum (spit) or other discharges, deposited on floors, sidewalks, etc., are picked up by shoes and so carried into homes. When handling shoes (putting on, taking off, etc.), discharges are transferred to hands, which go to mouths, or touch things that go to mouths. Therefore—

Avoid depositing discharges,—sputum, etc.,—on floors, sidewalks, or elsewhere where other people may step on them.

c. Mouth-spray is thrown out in talking, singing, coughing, sneezing, etc., therefore—

Avoid throwing mouth-spray into other people's faces by avoiding close face-to-face conversations, face-to-face recitations, face-to-face singing-exercises, etc. Cough, sneeze, etc., into a handkerchief always.

d. The air of a schoolroom in use necessarily receives mouth-spray into it in talking, reciting, etc.

e. Bladder and bowel discharges are carried by flies when flies can get at them. During early autumn and late spring or summer sessions, flies may carry these discharges from toilets to children's lunches, etc., therefore—

Make toilet-vaults fly-proof. Provide springs or weights to automatically close toilet-doors, and fly-screens for toilet-windows.

f. Three things destroy comfort and success in school work: Temperature too high; atmosphere too dry; air not in motion. Also, no child can work well in a poorly lighted room; but do not imagine that good lighting, good heating, and good ventilation will prevent spread of infection if infectious persons gain entrance. No school is a sanitary school if the children exchange their discharges without restriction; but only those schools where infectious persons are watched for and excluded are safe schools., therefore—

Note daily the general state of health of each child. No child who shows any decided change from the usual for that child, especially fever, headache, sore throat, stomach-ache, or general dumpishness, should attend school until seen by a physician. This rule permits early detection of infectious children. It also excludes children who should be excluded for their own good, even if non-infectious.

g. Children showing defective vision, hearing, breathing, etc., should be referred to the principal, superintendent, or school board for action.

All health officers know that adults in large proportion *will not,* and children *cannot,* boil the water. Moreover, the law in Minnesota now recognizes that the community has no right to supply water of such a kind that the consumer must protect himself against it. This principle should be extended, so that the community is held responsible for infection carried by any public route,—food, milk, or flies,—as well as by public water. Some day the equally logical step should follow,—the holding of the community responsible for *all* infectious diseases, by *whatever* routes they travel, including contact. The community, thanks to modern science, can abolish the sources of all infectious diseases; and once the sources are abolished, the diseases, being non-

existent, *cannot* travel by any route, even by contact.

The simple fact is, that the private citizen in his own home can protect himself against public routes of discharges as just outlined and from the family discharges to some extent; but the moment he leaves home and enters into relations with the general public, his individual control is at an end. He cannot guard, generally he cannot even ascertain, the sources or routes of the water, milk, food, or flies he must encounter. Above all, he cannot guard the sources or routes of the discharges furnished by the persons he necessarily meets. His children go to school, compelled directly by the law to do so, and there they share discharges which no personal defense through conduct can wholly avoid. He goes himself to work, compelled indirectly by the law to do so, and there he shares discharges which he can little or not at all control. Only the community can exclude infection from the public routes of discharges, water, milk, food, and flies; but also only the community can exclude infection from the private routes of discharges grouped under "contact."

Of course, the exchange of discharges already outlined, however inevitable, is harmless unless and until infected discharges enter into the exchange. The chances of encountering infected discharges can be approximated somewhat from the supposition that daily there goes at large, unknown, about one infective person in each 500 of the population. Hence, he who would defend himself from infection by his habitual personal conduct toward his associates must avoid the harmless discharges of 499 uninfected persons in order to avoid the harmful discharges

of one unknown infected person. (This estimate is necessarily a guess, and it does not include the venereal infections.)

The great weakness of the personal defense through conduct is this: The precise moment when it is most needed is the precise moment that it generally fails. In the first place, the mouth-spray of the ordinary well person is not half so abundant or so widely scattered as that of the case of tuberculosis, of measles, of whooping-cough, or of influenza, for these are just the diseases in which coughing and sneezing are prominent symptoms. The bowel-discharges of the ordinary well person are not half as likely to be disseminated as those of the typhoid or dysentery case, for these are just the diseases in which frequent, abundant liquid stools, often involuntary, occur. Again, the discharges of the well person are handled chiefly by that well person himself: the discharges of the sick must often be handled by associates unused to performing such services for others. Finally, exactly as green troops forget under fire all their parade-ground drill, trip over their own feet, and fire into the ground or at the sun, so the citizen, however carefully he may have practiced a well-thought-out system of avoiding discharges in ordinary life, goes all to pieces in the flurry when his child develops, say, scarlet fever. Of course, it is true that green troops soon recover their parade-ground drill, even in the face of the enemy; but they cannot do what seasoned troops can do, and the non-medical citizen can seldom protect himself in the face of infection as the trained contagious-disease nurse does, the physician, or the epidemiologist. Nevertheless, if he has previously known, and practiced even crude-

ly, the necessary precautions,* he is in a much better position to defend himself.

SUMMARY

The whole subject of public health divides itself into—

1. Securing high physical development and efficiency.
2. Avoiding disease.

Of the former we know little of practical application to the general population except in infancy.

Of the latter we know much of cure, but little of prevention, except in the environmental diseases, in the poisonings, as from lead, arsenic, alcohol, etc., and especially in the infectious diseases.

Defense against environmental diseases and the non-infectious poisonings is largely a matter of trade conditions and of avoiding dangerous, but known, non-living things and therefore largely of legislation, inspection, and conduct. Against infectious diseases, the sources being infected persons, defense is essentially a matter of precautions against those persons. The prime difficulty is the recognition of those persons. If they are not recognized, the defense becomes a matter of guarding against *all* persons.

Defense against infection may be divided into individual and community defense.

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*It is a fatal fallacy to believe in "general cleanliness" as a defense against infection. It is not the "general cleanliness" of surroundings that prevents infectious diseases; it is the **"specific** cleanliness" of freedom from infected discharges. Scrubbed floors, bright pans, neatness, and order do not necessarily involve, usually do not imply, hands free of discharges; they cannot stop mouth-spray. A gorgeous uniform no more shows ability to shoot than does "general cleanliness" show ability to avoid infection. It is not visible dirt that hurts,—mud, ashes, coal-dust,—but the usually invisible discharges in mouth-spray and on hands, and even these only when laden with infection.

Infectious diseases are carried by four main public routes—water, food, flies, and milk, and by a fifth private route, contact. By cooking *all* alimentary supplies before eating them, the public routes may be guarded at the consumer's end, but public opinion and, in the matter of water supplies, the law, rightly demand the transfer of this burden of protection to the producer.

The private routes of contact can be guarded by the individual also, but only by a ritual so elaborate and covering so general a field that it does not adequately meet the ordinary conditions of the ordinary life of the ordinary citizen, especially of hard-working fathers, hard-driven mothers and young children. Contagious-disease experts, with long, patient training and when dealing with known infected individuals, generally succeed; the ordinary untrained citizen must very often fail.

Notwithstanding that the community can and should assume the prevention of contact-infection (by excluding infection from the community entirely), as well as the care of the four public routes, the methods of personal defense should be well known to all; and there exists no means of teaching them comparable at all with the great public school system, for that, and that alone, reaches the citizens personally and in detail. There, in simple language, all that is useful can be readily taught, and it must be taught in the sixth grade, or earlier, to reach the population as a whole.

Chapter VII

COMMUNITY DEFENSE

THE PUBLIC HEALTH ENGINEER

The preceding chapter indicated the lines of personal defense against infectious disease which are available to the private citizen for his own protection through his own efforts.

The present and succeeding chapters will deal with community defense, — those operations which, if properly conducted by communities for the good of all, would make unnecessary the burdensome efforts of individuals to protect themselves.

The three great community measures for the abolition of infectious disease have been listed in increasing order of efficiency as—

1. The protection of all public routes of infection, public water supplies, public food supplies, public milk supplies, and public flies. This is now done in some places to some extent. Usually it is but half done, chiefly for lack of proper understanding of what are real protective measures, or of proper organization for their execution; too often, also for lack of proper men to carry them out.

2. The physical supervision of known cases of infectious diseases. This also is often now attempted. Indeed it is, on paper, the most developed of all. But its efficiency is cut down by

lack of reporting, concealing of cases from physicians, etc., and especially by lack of sufficient trained experts in epidemiology to do the close-to-the-ground daily work.

3. The sociological supervision of all infectious persons, already outlined in previous articles.

The first of these items is dealt with here.

For the protection of the public routes of infection three things are needed: proper physical construction, to exclude infection; proper physical operation, to maintain this exclusion; and the supervision of the human factor,—"the man behind the gun." A locomotive may be built perfectly and be kept in perfect running order; but the locomotive engineer himself is still the soul of the machine. Perfect physical equipment and perfect physical maintenance of public utilities related to the spread of disease, are enormously important, yet they are less important than the men who are to be in actual control of the actual operations. No better illustration of this can be offered than the fact that the milk supply from tested highbred cows, palatially housed, scrubbed, and vacuum-cleaned, has carried disease and death to its consumers, because one man engaged in handling the milk conveyed infection to it by the intimate personal contact which no organization or mechanism can wholly avoid.

Some of the worst water epidemics we have ever had were due to the human factor failing at the critical moment. This failure of the human factor, which is a commonplace in accidents by rail or boat, applies equally to all branches of public health, although the usual belief is that

almost any person is good enough to conduct public health work.

The reason for this commonly accepted belief is probably that public health work for the prevention of disease, or for the general physical advancement of the race, is often confused with certain measures which make merely for ease or comfort; and it is human nature to look down upon those whose services minister to our comfort. We forget that by our slaves we rise and by our slaves we fall. Too often they and their procedures are neglected so long as comfort and convenience are supplied by them without too much trouble to those who enjoy the fruits of their labor.

To define public health engineering in the light of the new public health principles, it must be defined as such work as deals through the physical construction and operation of physical surroundings and mechanisms with (a) the prevention of disease or (b) with the advancement of physical bodily welfare. If we include also, as is sometimes done, all such operations as conduce, however indirectly, to any kind of "racial advancement," we must add all engineering works, architecture, street paving, acoustic properties of public buildings, the size of doorways, fire-escapes, bridges, railways, and every other form of modern artificial surroundings, and with them their corollaries, noise, dust, the smoke nuisance, etc.

The line between true sanitary measures and those for securing mere comfort or convenience must be drawn somewhere, and it must be remembered that all "racial advances" are by no means advancements of public health. The railroads are of great sociological importance to the

race, but they often carry disease where disease would not have traveled otherwise. Every advance which leads to greater prosperity leads to more intermingling of people and to wider social relations and so involves a wider exchange of bodily discharges. The installation of a public water supply system adds great comfort, convenience, decency, and physical welfare, but it also provides a route of infection which leads directly into every home. If you put all your eggs into one such basket, you must *watch that basket*. A sewerage system, by getting rid of outdoor toilets, greatly conduces to decency, comfort, and cleanliness, and even obviates one danger of disease (carriage of toilet discharges by flies from the outdoor closet); but it also concentrates all those discharges into one foul union and the disposal of this often endangers other communities. There is no real advance in transferring the burden of infectious disease from one community to another by passing the sewage on from one water supply to another. Hence the true province of the Public Health Engineer is not the mere advocacy and construction of great engineering enterprises, but, rather, the supervision of the construction of such, to see that the public health harm they may do, if the public health view be neglected, is properly avoided, so far as physical construction or operation may avoid it.

The Public Health Engineer is not therefore, or, rather, should not be, merely what the popular imagination makes him, a man of sewer pipes and concrete; of water-meters, manholes, and pumps. The New Public Health Engineer will be a man of keen eye to see those features in all community construction work which may conduce

to greater exchange of discharges, a man who knows *just* what is needed for prevention of disease in such ways, and therefore can both provide proper precautions and at the same time avoid unnecessary and expensive precautions. The civil engineer has been defined as he who can do for $1.00 what any fool can do for $4.00. He is a physical economist. He insists on physical safety, but *within that limit* knows best how to achieve the needed safety without undue expenditure. The Public Health Engineer, dealing with water supplies, sewage disposal, etc., does just this thing. He guarantees sanitary safety, and *within that limit* he guarantees it for less money than the ordinary builder. Any keen student of infectious diseases can generally see the grosser faults in a supply which permit infection. The Public Health Engineer is a specialist. He sees these faults very much more quickly and surely; if they are obscure he has the skill and knowledge to disentangle them; and when he finds them, he knows how to correct them.

The Public Health Engineer is, or should be, much more than this, however. He is the only public health worker whose initial professional training necessarily makes of him a business man, in the sense of an administrator of operations on schedule time, and with economy of labor and expense. Those physicians who make good administrators in this sense do so because they learn it in administration, not because of initial professional training. This training of the Public Health Engineer makes him also the best man to supervise maintenance of public utilities, as well as to construct and equip them. Further, the absence of training in mechanisms and machinery so prominent in the training of most

health officials, makes of the Public Health Engineer the only public health man who can deal properly with the many mechanical devices for modern handling of the public routes of infection, on the perfection of which many lives often depend. The hypochlorite plant, the mechanical filter, the Pasteurizing device are machines. However well a physician may understand the underlying biological principles, he cannot figure the pitch of a cog-wheel or find the reason of the filter "loss of head" without infinite and wasteful effort, if at all.

The Public Health Engineer is in public health what the surgeon is in medicine, the "man of his hands,"—the actual operator. Whatever the physician may discover as surgically necessary to be done, it is the surgeon who must bring his skill and knowledge to bear upon the doing of it. So, although the epidemiologist, the vital statistician, the laboratory man must usually determine the sources and routes of disease, it is the Public Health Engineer to whom we must all turn wherever and whenever those sources or routes can be put out of action by physical construction or mechanical device, or when economic maladministration of public utilities is the real basis of the trouble rather than a physical condition.

The Public Health Engineer is not, however, as a rule, a man of a biological turn of mind. He generally takes vital statistics too seriously and, lacking medical knowledge, interprets vital statistics too mechanically. His own units of weight, volume, and measurement are fixed and definite. He has not learned to scan the unfamiliar units of disease, each by itself; nor is it likely that as a class he ever will. The spectacle of an engineer advising on a strictly medical problem

is only less sad, if less sad at all, than that of a medical man advising on a strictly engineering problem. It is in co-operation, each perfect in his own field, but aiding the other with real understanding of the other's problem, that well-balanced, sane advance is made.

So far as the five great routes are concerned,—water, food, milk, flies, and contact,—the engineer has so far found his chief field in dealing with water supplies. Even sewage disposal, so far as it is a sanitary problem, has as yet been chiefly considered in so far as it might affect the purity of water. But in the future the engineer must also deal with milk supplies, their production, transportation, pasteurization, disinfection; with the great fly problem and its chief corollary, the safe disposal of human excreta, as well as its minor corollaries, garbage and manure removal. Finally, perhaps chiefly, he must deal with the great sociological factors on which rests contact infection in public meeting-places,—the factory, the shop, the church, the theater, the school, even the tenement and the private home. Above all, the great engineer of the future is he who will see with trained analytical mind and act with trained administrative ability in organizing or re-organizing not one but a dozen of the many factors in the modern complex of society along lines which shall in themselves redistribute concentrated forces now too closely interwoven for mutual good.

But there must be more public health in engineering rather than more engineering in public health. This series of papers will have failed wholly in pointing out the real essential inside truth of public health progress if it leaves belief that infectious diseases can be abolished

through any physical or mechanical means. The great engineering operations of the day have an importance to mankind much greater in sociological and economic lines than in public health. But the public health end must not be neglected, even though we recognize that it can never be the great end of engineering, because no mere guarding of such *routes* of infection can abolish disease, and, if it could, there are far more direct, drastic, and simple measures to be enforced in other directions than in the protection of public utilities. Great engineering works are not essential to the abolition of infectious diseases, but great engineering works should be so conducted as to secure what reduction in such diseases it may. The ultimate abolition of infectious diseases rests with the supervision of the infectious individual, and no mere adjustment of surroundings can so affect his conduct as to compel that conduct along proper lines. But the public health engineer through housing, organization, and the proper construction and supervision of public utilities can so design the lines of least resistance that the public, who generally follow these lines, will find them plain and smooth, but hedged about with iron walls of safety.

SUMMARY

It is a complete misnomer to designate as a sanitary engineer him who merely narrows his attention from the principles and practice of engineering in general to the application of these principles for the purpose of constructing water supplies, sewage-disposal systems, rendering of garbage, etc.

A man is not a sanitary engineer because he can lay down sewer pipe any more than a man is

an artist because he can lay on paint. The Public Health Engineer in the true sense is he who has acquired so wide a view of modern life, of its mechanisms, and of the physical side of man's environments, that he can see and act through them for man's physical protection not merely from accident but also from disease. He does not just build sewers. When he builds them, he builds them as part of the great fabric of modern life. His plans are not merely so many feet of pipe, at such a price per foot: they are adaptations and applications of great fundamental laws to the physical advancement of mankind.

Chapter VIII

COMMUNITY DEFENSE

THE PUBLIC-HEALTH LABORATORY

The previous chapter discussed the relation of the Public Health engineer to the protection of man from disease, through the construction, operation, and direction of those public utilities already proved to be, at times, *routes* of infection.

Some day, when we have really determined the conditions which truly promote physical well-being, as distinguished from those which merely secure escape from disease, the Public Health engineer will find larger functions in a wider field, the supervision of the whole material surroundings of man.

The present chapter attempts to set forth the relation of the Public Health laboratory man to the same two divisions,—to the promotion of high health, on the one hand, and to the prevention of disease, on the other. Like the Public Health engineer, the Public Health laboratory man can as yet contribute but little to the former, and for the same reason, i. e., because so little is really known about it. Like the Public Health engineer, the Public Health laboratory man deals with the prevention of disease, and chiefly with the prevention of the infectious diseases. Again, like the engineer, the laboratory

man deals in part with *routes* of diseases, with those public utilities which at times form highways for the exchange of infected, and uninfected, bodily discharges. But, unlike the engineer, his work is not confined to *routes.*

The Public Health laboratory man, like the epidemiologist, deals also with *sources*, i. e., with the infected person. In some ways he goes further than the epidemiologist, for he deals with the infected discharges themselves, rather than with the person who discharges them; and, not stopping even there, he deals with, in those discharges, the very principles of disease itself,—the individual little particles of living matter whose activities in the human system produce so much trouble for us all.

This dealing intimately with the ultimate causes of disease is a fascinating, dangerous, peculiar life-work, an actual herding, handling, studying, of the very essences of the dreaded plagues of old. What would not the ancient philosophers and sages have given for one glimpse of a modern Public Health laboratory where matter-of-fact men handle, in their daily matter-of-fact routine, diphtheria plants, typhoid plants, tuberculosis plants, etc., quite as a student farmer handles potatoes or corn?

Because the little plants, or animals, perhaps, that produce many of our common diseases are as yet unrecognized, for instance, scarlet fever, measles, and smallpox, to name only three, the Public Health laboratory man's chief daily duties lie with typhoid, diphtheria, and tuberculosis. These furnish the bulk of his work. His chief services to mankind, in the temperate zone at least, consist in the aid he gives in recognizing those persons who are infected with one of these

three germs without showing conclusive, perhaps any, symptoms of their presence. True, he can and does perform like services in other diseases whose causes are recognized—such as anthrax, bubonic plague, cholera, glanders, leprosy, etc.; but these are so rare as to form only a flavoring for his daily grist. In the venereal diseases, also, the biological causes are known and can be recognized, but the laboratory man must await the development of the growing public demand for the handling of these diseases on a par with other infections, the taking up of these great subjects by legislative and executive authorities. Until that time comes the laboratory man can proclaim his own readiness and point to the road, but he can do little more.

With the *routes* of infection,—water, flies, food, milk, and contact,—the laboratory man has much to do, but, again and for similar reasons, he deals with these routes, in the temperate zone, chiefly when typhoid, diphtheria, or tuberculosis are involved. His functions in all this work are chiefly analytic, i. e., to find the particular water, or milk, or food which may be dangerous; sometimes to detect, if he may, the presence in them of the deadly germ itself.

Unfortunately, for reasons already offered in a different connection (see Chapter II), the germs of disease are very rarely found in water, food, milk, or flies. They live so short a life outside of the human, or animal, bodies which form their natural growing-grounds that the laboratory man seldom encounters them except in the body. The usual thing is, that long before a "sample" of water, etc., arrives at the laboratory, the disease germs it may once have held are dead or so outgrown by others that the best lab-

oratory methods must necessarily fail to find them.

So little is this understood that one of the almost daily happenings in every laboratory is the receipt of water, or milk, or food (flies, fortunately, are not often sent, as yet) from laymen, even from physicians, with the request that they be searched for typhoid or diphtheria germs.

But consider! Before a given water supply has attention called to it as a source of typhoid fever, typhoid fever cases usually must have developed from it. But typhoid fever is a disease which does not develop even its very first symptoms until, on an average, two weeks have elapsed after the germs first entered the body from the water supply. Usually, another week passes before the physician is called and perhaps another week, more often two or three, before the sample is sent; therefore five weeks is perhaps the usual time which has slipped away *since the typhoid germs were present in the water supply,* before the laboratory man receives a sample from it! Now, *two* weeks is probably the usual maximum for typhoid germs to live in water, even if the water be stagnant and in a dark place. When it is heaving, changing, exposed to the sun
? and wind and current, or flowing fast, as in a river, the life of disease germs in it is even shorter, and the chances of their dispersion and disappearance by the mere physical losing of themselves are almost infinite. To apply laboratory methods to finding typhoid germs in the ordinary sample of water taken from the suspected supply five weeks after the cases were infected, would be like shooting at the place where a flock of ducks *had been five weeks before.* "Hunting for a needle in a haystack" is discouraging

enough in itself, but suppose you knew the needle had been carefully removed before you began your hunt!

The laboratory man who examines water does so, not in the hope of finding typhoid germs,—he does not even try to look for them, as a rule,—but to find certain other signs of excretory pollution. Curiously enough, these signs are often of more real value to Public Health than would be the finding of the typhoid germs themselves, were that practicable; but to explain how this is would be out of place here. The point is this: The laboratory tests of the supposed routes of infection in any given case are made by methods and for ends wholly different from those which the public fondly imagines. The results obtained are often far more valuable than the public realizes or expects. At the same time, the definiteness of these results, because of the facts already outlined, are far inferior to those obtained in the laboratory examination of infected persons—in brief, the information from laboratory sources concerning "samples" usually requires elucidation and explanation in the light of all sorts of other information, sociological, meteorological, topographical, geological, etc. Considered thus, the laboratory work is nearly invaluable, but, taken by itself, almost as nearly worthless.

The happy ignorance displayed by those who think that an analysis of water, or milk, or food, even the most thorough, can in itself and by itself give useful sanitary information is equalled only by the joyful confidence of the southern darkey in a rabbit's foot.*

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*The British Medical Association at its annual meeting, held this year, passed the following resolution: "That this con-joint meeting of the sections of State Medicine and Bacteriology unanimously desires strongly to urge that no opinion as to the quality of

The true position of the laboratory in the coordination of public health workers which will rule in future organization, has been achieved but seldom.

The Public Health laboratory man of today has ceased to be the leader in public health endeavor which he once was, partly because he has been swamped with routine work in the lines he has himself developed, but chiefly because he is a laboratory man and because the very nature of his work has kept him indoors, out of and apart from the stirring fields of human life in being. Perfect enough in his own technic, he has perforce lost touch with all but his own work, and other lines of public health more closely involved with the outer world, have passed ahead of his.

The laboratory man must get out into the actual daily lives of the people and communities he serves. He must know outside conditions as well as those in the laboratory. He must work more closely with the engineer and the epidemiologist. He has his own place which they can fill no more than he can fill theirs, but he must understand their work, and they his, much better than at present.

Moreover, the engineer and the epidemiologist suffer from the present disassociation of the laboratory quite as much as does the laboratory man himself. Field work moves lamely, oftentimes, from lack of laboratory knowledge, just as laboratory work is oftentimes inert from lack of field knowledge. During the last few years the frequent transfer of laboratory men into the field

a water for dietetic purposes should be arrived at on bacteriological evidence without a local and topographical inspection of the sources of the supply made by a competent observer."

work of epidemiology and engineering has evolved a set of men who recognize this fully. But it is not by transferring laboratory men to other fields that the laboratory can be developed. It is by putting the laboratory itself into the field —and only so—that this can be accomplished.

In field work, and in research, so much neglected of late, the laboratory man will find his future, and he will not deal solely, as at present, with infectious diseases. True, the venereal diseases must be added to the present list of those for which routine laboratory facilities are provided. But some non-infectious diseases may become preventable diseases, if their causes are discovered, and the Public Health laboratory of the future, acting in conjunction with the physiologist and the pathologist, may find therein usefulnesses now undreamed of. Finally, as we slowly learn the true personal hygiene of food, clothing, sleep, exercise, etc., the Public Health laboratory will take its share in the greatest but least developed of all Public Health procedures, namely, the physical regeneration of the race.

SUMMARY

The Public Health laboratory finds its chief functions today in the detection of infectious persons (sources) and in the identification of infected things (routes) as a means to the end of abolishing those sources and blocking those routes. The average public health laboratory has been swamped with routine, cribbed, cabined, and confined until useful research has almost died out and real knowledge of outside conditions has been lost. The engineer and the epidemiologist have progressed fast and far by active contact with the needs of the outside world, and the laboratory can attain its proper future only by like development.

Chapter IX

COMMUNITY DEFENSE

THE PUBLIC HEALTH STATISTICIAN

In the development of the new public health principles, the laboratory came first. It dealt with the *causes* of disease at first hand, as well as with their *sources* and their *routes* of transmission. On laboratory findings all modern public health is based, although in practice the laboratory is necessarily limited, for daily service, to those diseases the causes of which are known.

But in its earlier work, the laboratory, inheriting somewhat the environmental teachings of the older school, paid more attention to *routes* than it did to *sources,* especially to the routes constituted by (a) water and (b) general surroundings. This focused attention on (a) sanitary engineering and (b) disinfection. It was in the earlier laboratory period that the sanitary engineer and the disinfector developed highly. It is true that the engineer deals almost solely as yet with but one *route,* water; and that therefore his efforts necessarily relate almost solely to the intestinal infections, mainly to typhoid fever. Nevertheless, so valuable were his services in reducing this disease, that engineering work was hailed at one time as the solution of all public health questions. Now the epidemiologist leads the van, because he deals not with *some routes,*

of *some* infectious diseases, but with *all sources* of *all* infectious diseases.

STATISTICS AS THEY WILL BE

But, through the work of the laboratory man, the engineer and the epidemiologist has for long been heard a still, small voice, offering a framework to bind them all together—to give coherence, correlation, and proportion—to outline the future, as well as to record the past, and, above all, to direct the present. This was the voice of the vital statistician. Much abused, laughed at, neglected, he is, or will be, guide, map-maker, intelligence-department, all in one; he is, or will be, like the cost-of-production scientific manager of modern business, "the most indispensable man on the staff."

True, his professional ancestors were helpless old gentlemen, raising their feeble voices in very feeble chants. A dry-as-dust historian of the wars of ancient Greece could lend more aid to a modern football team than the old-time statistician furnished to public health endeavors. Even now the new vital statistician is scarcely yet full-born. Hardly a health department now in existence collects in full or uses to full advantage one-tenth the information that it really needs. (A notable exception should be recorded here, the Richmond (Va.) Health Department under E. C. Levy.) The laboratory man has made some good statistics in his own field; so has the sanitary engineer—sometimes, alas, not wisely, but too well; the epidemiologist, also, from sheer necessity: but the new vital statistician has only begun to move. When he does move, fully equipped, alert, he will systematize, organize, and *use* the rich data so far largely wasted, this very

life-blood of public health endeavor, accurate, complete information concerning the way humanity reacts to human ills. Internal public health organization has been like the old-time factory, full of good workmen, but each working only his own line, with no one person knowing much about the business as a whole. At the end of the year the business, drifting along, perhaps showed a doubtful profit, perhaps a loss, but so long as bills and wages were somehow paid, who cared? Public health requires exactly the kind of man who has changed the face of business in the last fifteen years, a man who understands all parts of it, but does none himself; a man who knows costs in each department in proportion to production, and where to cut cost, increase production, save time, unnecessary work, and waste in general; alas, in health departments, a man to stop the one-half, now done uselessly in wholly wrong directions and to force development of the other half, now much neglected or left undone completely.

It is the vital statistician who must do this: collect the facts and set them forth inexorably, with mathematical precision. When it is done, our health departments will no longer use up $30,000 for garbage, with the probability that not a single life will be saved thereby, while spending $12,000 on *all other* health department efforts combined. Nor will a health department spend for terminal disinfection one-tenth its annual appropriation, to save no lives at all,* while using but one-fiftieth its appropriation for tuberculosis, which kills five times as many people as all the diseases usually "disinfected" put together.

*In tuberculosis, where terminal disinfection would be valuable it is not often done.

It will be said: "You are confusing vital statistics with health department finance; vital statistics deal with deaths, not money." Exactly—and that is just exactly what is wrong with them. Vital statistics are, in short, not *vital;* they deal with Death, not Life, with the "finished product" only of our slack, slipshod methods. They ought to deal, not with the dead, but who they were, and why and how they died, and why they were not saved. Suppose the factory manager knew at the end of the year merely his total product! Suppose that even this piece of information related, not to the way business went last year, but to the way it went *five years before.* "Historical records, and mighty poor at that," a modern public health man said in bitter scorn of the statistics of a neighboring state. The modern scientific manager must know not just the total product, though he must know that, and to the minute, not to five years before; he must know also all about the product, the kind, the quality, the cost, and why it is not better for the price. The modern vital statistician must know not only deaths, but why the health department is not stopping them; what its funds are; how they are spent or wasted; what work is being done; how much of value each division does; and all to the one end of saving life, not to the end of stopping nuisances, removing garbage, or cleaning streets—all admirable ends no doubt, but not life-saving ends.

But, it will be said, "Very well, but you are wrong in stating that Vital Statistics deal with Deaths. They deal with more than Deaths—they deal with Births and Marriages and con-

tagious diseases also." Yes, nominally; but to what useful end for public health?*

"Birth records quite often affect inheritance of estates in later years." True, and very useful to the inheritor they are when the time comes, but what has that got to do with *saving life* now? Marriage records also are invaluable in their own way, but they do not reduce tuberculosis one-tenth of a tenth per cent. Contagious disease reports, then? Surely they are important? Yes, but not as they are now collected. Misleading information is sometimes worse than none at all.

STATISTICS AS THEY ARE

The best way to show what public health vital statistics as they are today mean, or do not mean, is to give the story, true to life, as anyone who knows will quickly see, of the very basis of such statistics, the actual facts as they occur amongst the people.

Mrs. Anybody says to Mr. Ditto: "I am afraid Tommy has scarlet fever; I think he must have caught it when he was in the city." "Call Dr. A." "Yes, but they say he will report it, if it is scarlet fever. I'm nearly wild now with work. When the children are at school all day I manage somehow; with you and the children quarantined at home for a month I should go insane. I'll call Dr. B.; they say he never reports anything. I'll tell the neighbors it is scarlet rash. That's not a lie. It's a rash, and it certainly is scarlet. I'll let the children go to school, but I'll keep every one away from Tommy. I'd hate to think any other child got it from our children, but I guess that will be all

*Birth records, if they led to immediate investigation to see that the child was cared for properly, would be true public health data.

right. Tommy is not very sick yet. Don't go telling anyone he is sick. I'll tell the children not to, either. We don't want to have the milkman or the grocer afraid to call."

So Mrs. Anybody plans, and so it is carried out. But her heart is bigger than her head, and her plans go strangely awry.

She puts Tommy in a room by himself and runs over to a neighbor's for an egg or a cup of flour. When she comes back the other children are lined up in Tommy's room, solemnly inspecting the rash he proudly demonstrates to them. Next morning Tommy is "real sick," and after breakfast the mother puts up the other children's school lunches alternately with running in to Tommy's room to give him water or to hold the basin while he vomits or just to kiss and soothe him.

Poor, loving, hard-working mother! She has done the same through all the ages, taking infected discharges from the sick child, on her hands to put in the other children's food! No, she won't kiss them goodbye; she has been kissing Tommy; that is, she won't kiss any but the smallest one, who looks nearest to crying. That one's mouth she wipes with her apron before she kisses it—*she does not wipe her own!* Not that wiping either matters, for Tommy's mouth discharges are already in the lunch the little one marches out with, under its arm.

About 10 A. M., the empty house and the wailing child get on the mother's nerves. So she calls in a neighbor. "Tommy's sick. I want to go to the store to telephone the doctor. It's only scarlet rash. I won't be gone more than a minute, but I'm afraid he'll get out of bed or something. Will you keep an eye on him?"

The neighbor comes in, the baby on her arm, for is it not scarlet rash? But prudence strikes her suddenly, and she sets the baby on the floor before she peeks in at Tommy. "Hullo!" "Hullo, Mrs. Neighbor!" a feeble little voice replies. She steps in further, leaving the door open to keep an eye on baby. "Well, Tommy, how do you feel?" "Not very well," and he begins to vomit. She snatches a basin, holds his head, and in a moment surrenders him to his mother, and then takes her baby hurriedly home. A speck of vomit-spray has hit her hand. She did not notice it. The baby's fingers rest on it a moment, before it is dry; a minute later the baby sucks that finger. At home she sets the baby down and, conscience-smitten, changes her dress (*she does not wash her hands!*) and thereafter feels all right again because she thinks that *now* she can't give it to anyone, even if it is scarlet fever; besides, the doctor said it was scarlet rash.

Meantime, Mr. Anybody, summoned by his wife, hurries home in terror, finds Tommy still quite alive, growls, fusses, brings in some wood, pumps a little water, and then steps into Tommy's room, "just inside the door for a minute," before going down-town again. Tommy, with feverish, flushed face and heavy eyes under his tousled hair, calls feebly, "My daddy, my daddy"; and, of course, Mr. Anybody steps to his bedside to pat his head and kiss him, before hurrying back to business.

That night Tommy is worse; sorrow is on the family in earnest. Next morning Tommy is much better; the prayers and tears of the night before are forgotten; the mother, weary but joyful, lets the other children in to see him; "just for a minute now, but, anyway, he is so much

better"; and they all race out to school, shouting and laughing.

About five days later, Susan, the youngest, is not feeling very well towards evening, vomits during the night, is delirious next morning, with sore throat, swollen neck, and rash; and Dr. B. comes again. Serious measures are taken. The other children, in tears, are spirited away to a cousin's house to stay lest they should get it, and because the mother can't stand the strain of nursing the sick and caring for the well also.

Tommy has had it mildly, and by this time is up and about, wandering disconsolately through the empty house. To all inquirers the mother bravely maintains that Susan has only the scarlet rash and tells them Tommy will go back to school in a day or two. "I just sent the other children away because they were so noisy," she explains guiltily, wishing very earnestly that it was really so.

Next day Susan is *better.* (I am writing this —and therefore I make it thus. In real life, poor little Susan often dies, instead.) Everyone is cheerful again. Tommy is sent, very unobtrusively, to school because "he mopes at home, without a soul to play with." He is beginning to peel, and, in a day or two, is in much demand amongst his schoolmates, presenting them with souvenirs of flakes of skin they treasure as curiosities. Not that these scales do harm, despite the old beliefs. It is not the peeling, which everybody sees, that does the mischief, but the unnoticed slightly red sore throat that Tommy carries with him, and from which he infects his hands (and everyone he touches) and shoots out infection in his mouth-spray as he

chants his lesson, or whispers across the aisle, or sings in class.

And so the old, old story works itself out inexorably. One of the other children, staying at the cousin's, develops a slight sore throat. Were there an epidemiologist at hand, posted on the history of the child, to scan the enlarged papillæ of the tongue, note the large glands, and see the filmy membrane on the tonsils, the case would be recognized as scarlet fever, *sine eruptione,* i.e., without a rash. But as it is "it's only a sore throat." No physician sees her, because the cousin argues thus: "If it were my child, I'd have in Dr. A., but Mrs. Anybody wouldn't thank me for running up another bill here, unless the child is really ill; she's having Dr. B. now, for Susan, twice a day. I'll wait a day or two, anyway."

The sore throat mends, and the cousin feels she made a good judgment. But meantime the sore-throat girl has been sleeping with the cousin's little girl, and she develops it, too, but it also passes off. Then a week later, the cousin's little girl's school-chum, in a different school from Tommy's, has scarlet fever proper. Dr. A. attends, and reports it. The Health Department puts a placard up; the children are kept out of school; the father is kept at home; the whole population turns its eyes to that family and wonders where they got it. The village wiseacres, over the village bar, remind each other of the slough behind the house, or that the garbage from the family was never removed all summer. They say the well is shallow, "nothing but surface water," or the house is damp, or too much shut-in by trees, or any other fatuous foolishness that enters their empty heads. The mayor gives out

a statement to "allay popular excitement." He brands as malicious all statements that scarlet fever is rampant. There is but one "sporadic case," originating no one knows how. It is carefully quarantined, and "the Health Department believes the outbreak is well in hand and practically stamped out." The Women's Club demands the fumigation of the schools; and the epidemiologist, if he were only present, would gaze reflectively at Tommy's slight red throat, and gnash his teeth, and swear.* Poor Dr. A., who only did his duty, is blamed for all the trouble; and Dr. B. keeps mum. When, presently, Dr. C. is called to one of Tommy's schoolmates, he hesitates. He has not seen much scarlet fever, and he thinks, "perhaps it *is* scarlet rash—whatever that may be." He attends the child two or three days, and then he begins to ponder whether or not he had not best put the responsibility on the Board of Health; so at last he calls up Dr. D., the Health Officer. But Dr. D. has troubles of his own. "Do you say it is scarlet fever?" "Well, I don't know. I want you to go and see." The H. O. is perplexed. He does not want the reputation of finding a second case, after the Mayor has stated that there is only one; so he tells Dr. C.: "If you report it, I'll placard the house, but I don't want you to report it, if you are not sure." At this Dr. C. waits a day or two more, but finally reports it. Meantime a week of association of the other children with the sick one has elapsed, because Dr. C. did not *quite* know the finer points in recognizing mild scarlet fever early.

***Editor's Note.**—We regret the epidemiologist should do this, but we propose to give the facts, no matter whom it hits. Besides, we do not blame him much under the circumstances.

By this time, between the unconscious activities of Tommy and Susan, who are back at school, well oiled by Dr. B.'s advice, to keep the scales from showing, and of Susan's sister and the cousin's little girl (none of them recognized officially as scarlet fever), some twenty or thirty children in the two schools have been infected. Some of the pupils have had scarlet fever before and so escape this time. In others the disease is mild and passes unnoticed. In others "scarlet rash" develops. But several develop frank scarlet fever, not to be denied even by Dr. B., who, to give him credit, has begun "to get a little scared," and so reports one or two well-marked cases to relieve his conscience. Two or three deaths occur, and then the schools are closed, but not the Sunday-schools, or churches, or private sociables, or moving pictures, and so it drifts.

Now, see how all this affects vital statistics. The Health Department, in its annual statement, gives as the first case that school chum of the cousin's little girl. But we know that there were four cases before that—Tommy and Susan, and Susan's sister, and the cousin's little girl—but these do not go down upon the books at all. The Health Department adds thirteen more cases; that is, all those cases attended by Dr. A., faithful, conscientious man; about half of Dr. B's cases, those he had after he "got scared"; and some of Dr. C's, but only those he was absolutely certain of, not knowing scarlet fever very well. Dr. D. had no cases, because being health officer, the mothers felt that he would *have* to report them, and so did not call him.

The fact is, that any epidemiologist would find

that there were forty cases, but the books show fourteen.

Then consider the deaths. Two are reported properly as due to scarlet fever. But one of Dr. B's, really scarlet fever, not quarantined while ill, is reported "acute Bright's disease," because the doctor dare not say it died of scarlet fever after treating it a month without reporting it. It is quite true the child had Bright's disease, but it had Bright's disease because it had scarlet fever. Another dies of meningitis, due to middle-ear infection, the result of scarlet fever, but being meningitis, this death also goes in a different column. The more or less spoiled ears and the more or less spoiled kidneys of twenty other children who recovered never are recorded on the books at all.

Hence, fourteen cases where there should be forty; and two deaths, where there were really four, are recorded officially as scarlet fever.

This instance exemplifies practically the whole situation; mild, unrecognized, and concealed cases; cases to which physicians are not called at all; mistaken diagnoses; a superficial report covering a few of the severer cases only; death reports correct so far as they go, but not showing the relation of the death to the preceding disease. This occurs, not occasionally in a few communities, with scarlet fever only, but, almost every time, in almost every community, with almost every one of the infectious diseases.

The returns from Anybodyville are small in number, it is true; but multiply these by all the similar communities which make similar returns. Anybodyville reports two deaths and fourteen cases from scarlet fever, where there were four deaths and forty cases. This is "only" two

deaths and twenty-six cases wrong. But if one thousand communities report similarly, our statistics are wrong two thousand deaths and twenty-six thousand cases.

Moreover, see how the percentages are twisted and tangled. Two deaths from fourteen cases is about 14 per cent. Two deaths from forty cases is 5 per cent. Four deaths from fourteen cases is 28 per cent. Four deaths from forty cases is 10 per cent. When we remember that the number of cases of scarlet fever, and of other diseases, is often calculated from the deaths by the percentage which the deaths *usually* are of the cases, we find that we can calculate the cases from one hundred deaths of scarlet fever (on the above returns) as seven hundred, two thousand, three hundred and fifty, or one thousand—how *very* valuable!

SUMMARY

The vital statistician of the future will be the scientific manager of a business department, for, through the epidemiologist working in the field, he will know where the diseases *are*, not where they *were*, and he will know which disease demands the most attention. He will know also what resources, in men and money, the health department has, to fight its battles with. The correlation of these two factors has seldom been achieved, rarely even attempted, in public health circles, although in life insurance it has long been known that their inter-relations were the absolute *sine qua non* of success. Any business man's first step in reorganizing public health for actual service would necessarily be (a) to determine what requires to be done; (b) to determine what there is to do it with. The max-

imum *required* returns from the minimum *necessary* expenditure should be the only motto. To secure this information, no one but a statistician knowing statistics, but knowing men and things as well as figures, can succeed. To confine his work to deaths, even to cases, from preventable diseases, is to study output only, with no regard to income. To study income, as is so widely done, without regard to whether that income is spent to achieve lessening of disease and death or merely for nuisances or smoke inspection, is simple madness.

Chapter X

COMMUNITY DEFENSE APPLIED

TUBERCULOSIS IN GENERAL

Previous chapters have outlined the general principles which govern modern public health efforts. The present chapter will show the specific applications of these principles to one specific infectious disease, namely, tuberculosis. This disease is selected because the same principles that apply to all other infectious diseases apply to it and because it is the most important of all the diseases now recognized as really *preventable*, with the exception of the venereal diseases.

Tuberculosis, in all forms, is due to the growth, somewhere in the body, of a certain germ, exactly as diphtheria and typhoid are due to the growth, in the body, of certain germs. There are many very definite individual differences, in the size, shape, manner of growth, etc., of the three different germs of these three different diseases, and these differences make it perfectly possible to distinguish each germ from the others, just as any farmer can distinguish oats, corn, and potatoes from each other.

But just as there are different varieties of potatoes, so there are at least two varieties of tuberculosis germs which affect human beings. One variety is what is known as the human tu-

berculosis germ proper. The other is found chiefly in cattle and is therefore called the cattle tuberculosis germ (the bovine tuberculosis germ), and this name is given to this variety even when it is found in the human, as it sometimes is.

HUMAN TUBERCULOSIS

A most important difference that the germs of human tuberculosis, of diphtheria, and of typhoid fever show amongst themselves is not a difference in size, shape, etc., but in the parts of the body each selects. Thus the diphtheria germ flourishes chiefly in the nose and throat; the typhoid germ flourishes chiefly in the intestine and perhaps the blood; while the human tuberculosis germ will flourish almost anywhere in the body, glands, bones, joints, intestine, kidney, brain, lungs. This selection is no mere accident, although we do not know how it comes about. All three germs enter the body chiefly by the mouth, conveyed thereto chiefly by the *hands*, but also more or less through food and milk, and, in the case of typhoid fever, through water and flies. On entering the mouth, all three germs, which are of course far too small to taste or feel, are swallowed in the food, milk, etc., in which they happen to be present, or merely in the saliva; if, as is most usual, they reach the mouth directly or indirectly from the fingers. Once swallowed, all three pass into the stomach, where many are killed by the acid there present, the survivors, if any, passing on into the intestine. On this journey from mouth to intestine, some are left, of course, by the wayside, stranded on the tonsils, throat, gullet, etc. Here at once is shown their respective peculiarities. Of all the diphtheria germs that are thus swallowed, prac-

tically only those that are stranded in the throat, will flourish; those diphtheria germs which pass on into the stomach or intestine are destroyed or pass out harmlessly. On the other hand, typhoid germs, if stranded on the throat, do not flourish there, nor do those which reach the stomach flourish in that organ. It is only those typhoid germs which survive the journey until the intestine is entered that can succeed in producing typhoid fever. The human tuberculosis germ has a still longer road to go. Not only must it pass mouth, stomach, and intestine; also it must be absorbed from the intestine into the blood, as the food is; but it does not grow in the blood. The blood is only a river, by which it can be carried to a favorable developing ground. We do not know at all why human tuberculosis germs entering the blood thus, should finally settle and grow in a joint in one person, in a lung in another, in a kidney or a gland or a bone in another. However, this is the way in which these different forms of human tuberculosis develop. The old idea that human tuberculosis of the lung (consumption) is contracted chiefly by breathing the germs directly into the lungs has been definitely upset. The lungs are infected from the blood-stream chiefly, just as are the other internal organs, bones, and joints.

Another and, from the public health standpoint, an even more important difference exists. Diphtheria germs developing in the throat, and typhoid fever germs developing in the intestine, can readily escape from the body: in the case of diphtheria, through the mouth and nose discharges; in the case of typhoid fever through the bowel, and sometimes the bladder, discharges.

It is the escape by these channels of these germs from the body which makes these diseases "catching" or "infectious" or "communicable," for if they could not escape from the body they could not reach other persons and therefore could not be "catching." But in human tuberculosis, most of the places where it develops,—bones, glands, joints, etc., — are not connected with any opening of the body by which the germs may leave the body. These forms of tuberculosis have no great highway to the outside lying at their doors to carry the germs out to other persons. Practically only in human tuberculosis of the lungs are such highways provided for the human tuberculosis germs, although sometimes in bladder, kidney, and intestinal tuberculosis. But in the latter forms, the germs do not, as a rule, pass out by the highways provided for them in such condition or such numbers as to be of serious importance in propagating the disease. In human lung tuberculosis, on the other hand, the windpipe, throat, and mouth form a highway, along which the germs may escape from the affected lung in such enormous numbers that twenty-four billion per day have been detected in the discharges (sputum) from the lung of a single advanced case, although the average number from the average case is usually "only" four or five billion daily.

Thus it comes about that human tuberculosis of the lungs is the only common form of human tuberculosis which is much to be feared as infectious. Practically all the other forms of human tuberculosis are derived from the sputum of cases of human lung tuberculosis, carried chiefly by mouth-spray and on the hands, and if cases of human lung tuberculosis did not act to

spread infection to other persons, all forms of human tuberculosis would quickly disappear.

Moreover, even human lung tuberculosis is not very infectious in the early stages, i. e., when the germs are growing in the lung tissue, but have not yet reached the air-passages, because, until then, the germs cannot escape into the windpipe and so by the throat to the mouth. When in the later stages the germs reach the air-passages the way for the escape of the germs to the outside and so to other mouths is "open." Persons in this stage of tuberculosis are called "open" cases, and it is therefore only the "open" cases that are seriously to be feared as infectious.

THE ABOLITION OF CATTLE TUBERCULOSIS OF THE HUMAN

Although the cattle tuberculosis germ differs from the human tuberculosis germ somewhat in size, shape, etc., the most important public health difference is this: the cattle tuberculosis germ seldom produces lung tuberculosis in the human. It produces bone, gland, joint, etc., tuberculosis, but lung tuberculosis hardly ever. Consider how important this fact is. It means that *cattle tuberculosis existing in a human can very seldom be conveyed from that human to another human.* In other words, cattle tuberculosis may be transmitted from cattle to man, but practically is not further transmitted from man to man. To prevent cattle tuberculosis in the human, we do not need to take into account existing cases of cattle tuberculosis in the human, but only existing cases of cattle tuberculosis in cattle. If we free our cattle of cattle tuberculosis, we shall free our humans of cattle tuberculosis also; and this is the only practical way that cattle tuberculosis in the

human can be abolished unless and until the human race abandons the use of cow's milk raw.

THE ABOLITION OF HUMAN TUBERCULOSIS

How can we abolish human tuberculosis? Exactly as we can, and some day shall, abolish any and all other infectious diseases, by killing off the germ that causes it, exactly as we have almost abolished the race of buffalo by killing off the existing buffalo. We know well enough that when the last buffalo is dead, no man, however wise, no government, however powerful, could ever produce another buffalo. So, once the existing diphtheria or scarlet fever or tuberculosis germs are all dead, there is no way under heaven by which these particular germs could be produced again. Those which exist now are not "evolved from dirt" any more than are buffalo or roses. Those which are living today are simply the descendants of those which existed yesterday and so on, just as in the case of buffalo or roses, back to the dawn of history. Once any race of plant or animal is wiped out, it can never be redeveloped; and the tuberculosis germ, just as well as the germs of diphtheria or typhoid fever, can be abolished exactly as the megatherium or dinosaur has been abolished, i. e., by killing off the existing individuals.

"But consider the enormous numbers and the tiny size of germs and that they are present *everywhere,*—in air, water, food, milk, dust; in and on everything we touch or taste or handle. It is quite impossible to kill them all."

True, *germs* are everywhere but *not disease germs.* We know some fifteen hundred or more species of germs and hardly fifty of these produce disease, while only two, already mentioned, produce tuberculosis in the human. That these

germs are very small and cannot be slaughtered individually like buffalo, is true, but it is also true that their very minuteness means that billions can be slaughtered at a time, if they are only kept together. As to tuberculosis germs being everywhere, all over, outdoors and indoors—this is *not* true. No more important fact in public health has ever been formulated than this, due to that keen leader in public health, Chapin of Providence: *The germs that produce disease* are *not* ubiquitous, *not* in dust everywhere, water everywhere, milk everywhere. They are chiefly, almost wholly, *in the bodies* of a relatively few people, or animals; and when they escape from those bodies, where alone they find the peculiar food, high temperature, abundant moisture, and darkness which they need, they promptly die or become harmless. Even in water, milk, food, etc., into which they may be introduced from infected persons, their lives are short, and they must quickly reach a new living victim, or die.

To abolish any one race of disease germs is far easier than to destroy some much larger things. Thus to abolish flies means not only killing all flies, indoors in all houses everywhere, in all stables everywhere, in and around all dwellings everywhere, but also throughout all fields and forests, mountains and valleys everywhere, because flies are hardy outdoor beings as well as indoor beings. They can breed and flourish almost anywhere, where any kind of food, even in vanishing quantity, is to be had. Moreover, they can move of their own volition with promptness and despatch, have quick eyes and quicker wings to escape designing enemies, and in a thousand ways can take care of themselves.

Disease germs, in contrast with the fly, are

very tiny and helpless particles of protoplasm, having no eyes to see an enemy, no nose to smell him, no means of running away from him. They cannot flourish on almost any food, but need the living tissues of the human body; they cannot grow at almost any temperature, but must have the heat of the human body. In brief, they are not merely indoor plants: they are incubator plants and cannot grow, thrive, or reproduce themselves in nature, except in the incubators, our bodies, or, in a few cases, animal bodies, provide them. Hence if we were able to take a visual census of all the living tuberculosis or scarlet fever or diphtheria germs in the world we should see them, not in the dust everywhere, the water everywhere, the food everywhere, etc., but in a very few places only, and those places would be, in almost all cases, the bodies of humans (or animals).

Indeed, we can foretell just about what the census of tuberculosis germs in any district of the temperate zone, would show. It would show about one person in every seven hundred of the population carrying a large number of active, living, growing germs in the lungs,—germs that were escaping to the outside and reaching other persons' mouths. It would show also a number of other persons in whom the germs were present in joints, bones, glands, etc., but not escaping to others; and it would show a number of persons affected in the lungs, and, later, likely to develop to the point where the germs could escape, but practically harmless to others so far. Beyond this, hunt high, hunt low, search garbage barrels, manure heaps, dead animals, dusty streets, sewage, water, foods, milk, etc., and human tuberculosis germs, alive, growing, capa-

ble of producing the disease, *would not be found* True, in the immediate neighborhood of the "open" cases the sputum they throw out, their mouth-spray, and their hands would show the germs, and things they spit into, mouth-spray into, or touch, would show for a short time a few; but these would be dying or already dead, holding out danger to other persons only during the short time which elapses between leaving their happy homes in the human lung and death outside from drying and starvation. This applies, not to tuberculosis germs alone, but practically to all the germs of the ordinary infectious diseases, anthrax and tetanus forming two chief exceptions, both rare diseases here.

No person energetic enough to advocate the abolition of the fly should hesitate a moment to advocate the far simpler, smaller, easier, and far more important work of abolishing those germs that alone can make the fly a danger.

In brief, the method, and, I believe, the only rapid, complete, effectual method of abolishing human tuberculosis, is this: find the "open" cases and prevent the spread from them of the germs they alone throw out in numbers and condition to be feared. That means, find the one person in every seven hundred whose infection threatens all the rest, and supervise him just enough to keep his discharges from entering other people's mouths.

How is this one person in every seven hundred to be found? Not without hunting, not without ingenious, skillful, deliberate, sagacious, well-trained hunters, epidemiologists as devoted and persistent in their work as the average insurance agent is in his,—men who devote themselves to

the abolition of tuberculosis as whole-heartedly as any merchant does to making money.

And how? Where shall we begin? Must we canvass the whole population one by one? True, that would do it, but epidemiology has found a simpler, keener, more scientific, far more economic plan, illustrated for typhoid fever in a previous chapter. Begin with the known cases and search the zones of infection surrounding each for mild, unrecognized, and concealed cases. (In tuberculosis the search for carriers is probably unnecessary, certainly at the present time.)

"But why not concentrate on the incipient lung case, the case that may be cured, and by preventing this case from going on to the "open" infectious stage get rid of danger to others thus, instead of by attention to the open case?"

For several reasons, the abolition of tuberculosis through care of incipient lung cases only cannot at present be accomplished.

1st. Because incipient cases, in the truly incipient "non-open" stage, are discovered, perhaps are discoverable, in a very small percentage only of their total number.

2nd. Because a large proportion of the incipients so found would *not* go on *in any case*, whether found or not, to the open stage; and the time and money and efforts spent in finding and supervising them would have been relatively wasted.

3rd. Because a certain proportion of the incipients so found *would* go on, *in any case,* to the open stage, and thus become infectious cases, despite all efforts. In these alone would the efforts expended be of service in preventing new cases. The trouble is that, in the incipient stage,

it could not be determined whether or not the case would so develop.

4th. Because the time and attention devoted to incipients, to prevent them becoming open cases, would imply, as it has, alas, so far implied, neglect of the advanced "open" cases, in which the danger of infection is so immensely greater.

5th. Because if all the incipient cases were discovered they would form a mass of persons so great as to be beyond handling properly by any at present even dreamed of force of attendants, etc. If, as at present, only a very small proportion were found the actual situation would not be materially changed.

"Would you then cease the care of incipient cases in sanatoria, and concentrate wholly on the advanced case?"

No. First, because the tuberculosis sanatoria, intended though they are for incipient cases, really handle very many "open" cases, and to that extent prevent new infections; secondly, because the tuberculosis sanatoria do, in a measure, fulfill their proper function of cure for incipients and even early "open" cases to some extent and hence save life. But as a means of *abolishing* tuberculosis, the ordinary tuberculosis sanatorium for incipient cases is quite hopeless.

The thing to do first is, find the recognized "open" cases, whether they be in early, advanced, or late stages, and place *them* where *they* can spread the disease no further. Then search the "zones of infection" surrounding them, i. e., their relatives and associates, for mild, unrecognized or concealed cases, and also for incipients, handling all "open" infectious cases thus found, in the same manner. This system would begin at

the right end by stopping further infections, and would incidentally find those early "open" and "non-open" incipient cases wherein sanatorium treatment would be of most avail.

SUMMARY

Tuberculosis is a typical infectious disease, and it must be handled on the same principles as any other infectious disease; hence, by blocking the routes of infection, but chiefly by finding the *sources* and preventing spread thence.

Of the five great routes of infection,—water, food, flies, milk, and contact,—human tuberculosis travels chiefly by contact, through sputum, mouth-spray, and hands, directly, or almost directly, from patient to prospective patient. Practically, it is spread exactly as scarlet fever or diphtheria is spread. Public flies and public food supplies are comparatively insignificant conveyors. Public water supplies are almost negligible, and public milk supplies act chiefly in conveying cattle tuberculosis to man, although, if the milk be handled by tuberculous humans, it may convey human tuberculosis also.

It is evident, then, that blocking of the routes, since the chief one is contact, involves chiefly the far more important measure of finding the source, just as in scarlet fever, or diphtheria, and if these sources are found and prevented from gaining access to the routes, the routes may be disregarded. The measures for finding the human sources, practically the "open" cases of *lung* tuberculosis in the human, are epidemiological and have already been discussed in principle before (Chapter V.)

The measures necessary for finding the animal sources (infected milch cows) are the well-

known tuberculin test of herds, with proper repetitions, and the elimination of the tuberculous animals. Serious enough as cattle tuberculosis in the human is, its prevalence, nevertheless, is much less than that of human tuberculosis and its infectiveness in the human is nearly negligible. Hence, if our efforts were concentrated wholly on human tuberculosis, more cases and more deaths would be prevented in one year's work, than efforts on bovine tuberculosis, however successful, could possibly achieve in many years.

Chapter XI

THE CONCLUSION OF THE WHOLE MATTER.

THE DOING OF IT

If previous chapters have succeeded in the very earnest attempt they made to show what the new public health principles are and how they have become established, the one momentous matter in public health still left unsolved is this—why, why, why are not these principles observed? If we know how to do it, why is it not done?

Chiefly, because the general public does *not* know. They still believe religiously the theories that were beginning to be discarded in scientific circles twenty years ago. To any one who has discussed these subjects before lay audiences it becomes most evident that people the most refined and educated still believe, concerning public health, almost the same things that the most ignorant hold. So long as these beliefs control public opinion, so long will public health lag far behind other advances. Four of the most common fallacies the writer's experience of public discussion has elicited are illustrated here, and the reader may easily test his own state of knowledge by asking himself what answers he would give to the questions here presented:

THE CHIEF OBJECTIONS.

1. If the disease germs are not evolved afresh from dirt or decomposition, but are descendants of their forefathers, where did the first disease germ come from?

We do not know. Where did the first wheat come from? Or the first horse? We know that we can get no wheat *now*, except from wheat, nor horses except from horses. These germs are plants or animals, exactly as wheat or horses are. That they are tiny no more changes this law of descent than does the enormous size of a whale or of a redwood tree. "All life from life" holds true in nature through the whole scale, from germ to human beings. Besides, under the microscope, we *see* the germs "descending" from their forefathers.

2. If dirt does not breed disease, then why are dirty people so subject to disease?

Dirty people are no more subject to disease than clean. Infection, if it reaches either, may yield disease in either; if it reaches neither, neither will suffer. If an infectious disease enters a household, the dirtiest people will not spread it, despite their dirty habits, *if they avoid the one specific "dirt"* (the discharges of the patient) which alone is harmful; the cleanest people will not fail to catch it if, in their general cleanliness, they neglect that same specific "dirt." True, dirt, carelessness and disorder offer some indication whether or not the people who show these characteristics would have the sense, or take the trouble, to avoid the one dangerous "dirt," should it appear. On the other hand, cleanliness, thrift, and system indicate characters likely to handle infectious "dirt" with the same care they show in other matters. But the dirtiest people who make the proper efforts to avoid infection can and do many times escape, remaining as dirty as they please in other ways. The cleanest people who neglect or do not know the methods can and do suffer.

3. If you tell people "dirt" does not breed disease, you are praising dirt — upsetting all the careful uplift all the best people have attempted for many, many years.

Suppose a *water*-pipe is leaking in your house, flooding the floors and damaging everything. Suppose that when the plumber is hurried to the rescue, he tests the *gas*-pipes, finds a leak, stops it, and tells you all is well. What would you say? True, the *gas* leaked; it was right to stop it: but the *water* goes flowing on! Suppose to your objections he replies: "But think how bad the effect would be on our campaign against gas-leaks, if we failed to urge that gas-leaks must be stopped, whether that stop the water-leaks or not. If I admit that gas-leaks have no connection with water-leaks, you would let the gas flow on. I *must* make you believe the water-leak depends on the gas-leak, else you won't fix the gas-leak." Stopping gas-leaks cannot help water-leaks nor *vice versa*. Reducing disease will not make people "clean," nor will making people "clean" reduce disease; only the one "cleanliness" of avoiding infected discharges will gain this end.

4. Why do you talk so much about disease? Teach healthy living, keep the body strong, well clothed, well fed, and you need not fear disease, especially infectious disease, at all.

This is a fallacy so widespread that even physicians teach it, in good faith, without considering that they themselves would never let their own children, be they never so healthy, run with a measles case, or mumps, or scarlet fever, unless their children had had the disease before. If the teaching is not good enough for practical

application to physicians' children, it is not good enough for public health.

You see, everyone knows that children who have had measles very seldom take it a second time, and this without regard to whether they are robust or sickly, healthy or weak. Everyone knows, too, that children, healthy or sickly, who have not yet had measles, almost invariably catch it if they are exposed. Practically, the same is true of scarlet fever, mumps, whooping cough, smallpox, chickenpox, etc. It is not so true of tuberculosis, diphtheria, or typhoid, since those who have had tuberculosis, diphtheria, or typhoid may get it again; although again without regard to whether they are healthy or sickly.

In measles and the other diseases like it, persons exposed who do not contract the disease, escape, not from good health, but just because they have within their bodies a certain antidote to the particular poison of that particular disease. Anyone can prove this to himself, if he will think a moment. If general good health really did protect against these diseases, a child who could not catch measles, *because protected by his general good health,* could not catch scarlet fever, either, for the same general health would save him from them both. But everyone knows that the child who cannot catch measles (because he has had it) must nevertheless be guarded from scarlet fever, unless he has had that too. In brief, an attack of these diseases gives, in most persons, an immunity; that is, an antidote is formed, which then protects them from having it again. But there is a *different antidote* for each disease. Having had measles once is excellent protection against measles, but

it is no protection at all against scarlet fever or mumps or any other illness.

In diphtheria an antidote is formed, but often disappears again, and therefore this disease may be suffered more than once. In typhoid also an antidote is formed lasting a year or two. We know and are learning more of this antidote against typhoid. We do not know yet much about that which perhaps protects against tuberculosis.

Now, no one dreams that the antidote for measles can be developed by diet, exercise, or clothing; by fresh air, drugs, or anything in fact, except by suffering an attack from the measles germ. Nor can anyone seriously believe that the antidotes for typhoid, or chickenpox, etc. (except that for smallpox vaccination takes the place of an attack of smallpox) can be developed except by equivalent means. If "good health" will not protect against any of these diseases, taken *one by one*, how can "good health" protect against *all* of them taken together?

So we might deal with fallacy after fallacy, all based, however, on two.

POPULAR FALLACIES

The first of these is that infectious diseases come from "general bad surroundings." The truth is that they come solely from certain germs growing in the body, and practically the only sort of "bad surroundings" which cause infections is association with one of these infected bodies or with its discharges.

The second great basic fallacy is this, that "general good health" protects against infection. The truth is, that the only true protections against germs we know are, first and best, to

keep them out of the body; and, second, to have within the body the *special* antidote for each *particular* germ. We vaccinate against smallpox, but that does not save us from typhoid fever. We vaccinate against typhoid fever, but that does not save us from smallpox. If we could vaccinate against every disease (as perhaps some day we shall be able to do) we would be safe, despite the germs, at least while the protection lasted, and after that we could vaccinate again.

But how much better to avoid the germs, which means avoiding the persons in whom they are; and then we would never need any sort of vaccination!

Surely, the thing to do for one's own sake, and still more for the sake of our associates, is to find the infected persons, or animals, that alone can cause disease in the true sense, and keep them so protected while the danger lasts that they will do no harm. Then, when their stock of germs is dead and done with, remove all the restrictions.

NEW FASHIONED QUARANTINE.

You will say that that is only old-fashioned quarantine. It is, in principle, but modern practice changes it so completely that, practically speaking, new-fashioned quarantine differs from old as much as motor cars differ from camels. In the first place, old-fashioned quarantine did not pick out *all dangerous persons*, but took the sick who form but *part* of the infected, and also took the well who were found with the sick, including thus some who were not infected, and kept all these practically in prison, in their homes, or ships, or wherever else they were staying.

Thus, not alone were many infected persons overlooked and many uninfected persons wrongly held, but also the disease spread oftentimes from those infected who were in the net to the uninfected who were kept in with them, so that old-fashioned quarantine, while it protected the community but partially, meant often poverty, disease, and death to those caught in its toils. No wonder the very name of quarantine makes many people shudder.

New-fashioned quarantine is not a blanket method, blunderingly catching in its blindfold grip both sick and well, the harmless and the harmful, indiscriminately. New-fashioned quarantine requires definite detailed knowledge applied with care and patience, not mere force.

Now, everyone wishes infectious persons handled so that infection ceases. Even the infectious do not wish to spread their own infection. The thing that chafes and riles the average person is not restriction but unjust restriction; either restriction of non-dangerous persons, or restriction of some of the dangerous only while others just as dangerous go free.

No mother minds the exclusion of her infectious child from public school, if her neighbor's infectious child is excluded also. Every physician would report his cases if every other physician did so too.

Here then is the solution, based on human nature, on common sense, and on the most scientific knowledge. Find, through the methods of epidemiology, of the laboratory, and of the vital statistician, skilfully combined by experts, these dangerous persons, whether sick or well—these only dangerous persons, those who carry on them or in them, germs of infectious diseases. Set

all others free, but keep these persons, not in old-fashioned quarantine, but under such control that their discharges will not pass to others; and do not measure the length of that control by fixed time limits, blind and unjust as quarantine itself, but measure it wholly by the length of time the germs remain in or on the body. The moment that the germs have left those persons they are no longer harmful and they should be freed.

To do this properly means intimate attention and supervision of infectious persons by men who know their business and do nothing else. If one such man to every 20,000 persons began, tomorrow, everywhere, his work, infectious diseases in ten years would have vanished and would have become mere history.

SUMMARY.

This, then, is the conclusion. The old ideas have passed; the new are no longer theories but facts; the methods they require are not untried; they have been practiced for years in Minnesota. The details are worked out, the field is ready, the scope and cost are known. All that remains is to apply the methods developed in this state to all infections, thus wiping them all out, once and for all. The way is clear, what remains is to follow it; the method is known, what remains is to carry it out; the thing we, as a race for centuries have prayed for, can be done; all that remains is to do it.

Each generation of Minnesotans pays now for infectious disease, two hundred million dollars at the least, *and has the diseases, too!* Why not pay one-tenth this sum and rid ourselves of all of them forever?